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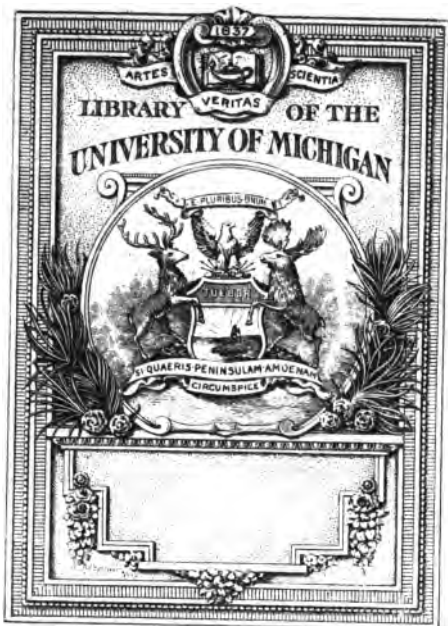
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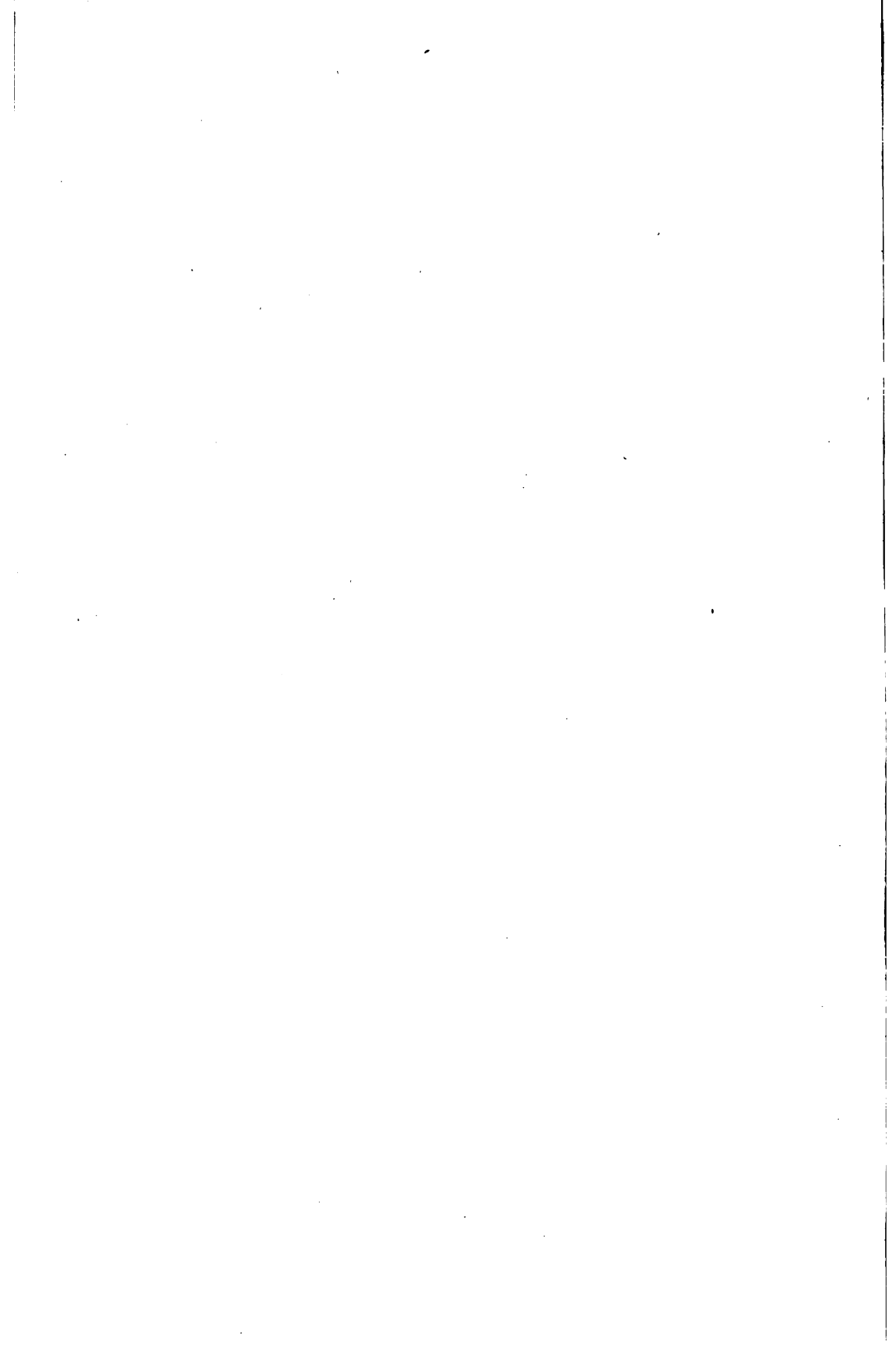
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A
PRACTICAL TREATISE
ON
96485-
APPENDICITIS

PREPARED ESPECIALLY FOR THE USE
OF
STUDENTS AND GENERAL PRACTITIONERS

BY
HOWARD CRUTCHER, M.D.

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ILLUSTRATED

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1898

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BY
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TO
His Old Teachers in Medicine and Surgery

THIS BOOK IS INSCRIBED

AS A SMALL TOKEN OF GRATITUDE BY THEIR FORMER PUPIL

THE AUTHOR

PREFACE.

THE aim of the author has been to prepare a helpful book, along practical lines, for the use of those whose bedside experience in appendicitis is limited. Much technical and theoretical matter has been purposely omitted as not coming properly within the scope of the work.

It has throughout been the author's desire to present generally accepted rules of practice in preference to purely personal methods. The widest liberty of personal belief and action, however, is not only clearly recognized but cordially upheld.

The author's contributions to the subject of appendicitis, covering a period of years, have appeared in *The Medical Record*, *The Medical Visitor*, *The International Journal of Surgery*, *The Medical Era*, *The Homœopathic Physician* and *The Hahnemannian Advocate*, but as this book was not written with a view to the exploiting of purely individual experiences he has questioned the propriety of introducing even illustrative cases from his own practice.

Proper acknowledgments have, it is believed, been duly indicated in the text in all cases where direct references have been made; but, in a larger sense, a general and grateful tribute is due to the labors of PARKER, SANDS, FITZ, MCBURNEY, MORRIS, SENN, SHRADY, RICHARDSON, VAN LENNEP, FOWLER, BERNAYS, TREVES, WYETH, DEAYER, MURPHY and WHITE—names that have made the surgery of this century glorious for all coming time.

The especial thanks of the author are hereby expressed to Dr. FREDERICK O. PEASE, whose artistic skill in illustrative work will doubtless meet with full appreciation upon the part of the reader.

The mechanical excellencies of the book are due to the kindly services of Dr. J. B. S. KING.

H. C.

CHICAGO, *October, 1897.*

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A
PRACTICAL TREATISE
ON
APPENDICITIS.

CHAPTER I.

The Vermiform Appendix.

THE vermiform appendix is a slender tube of rudimentary gut, which arises from the base of the cæcum.

Its location is somewhat variable; it has no established physiological function, and no fixed histological characteristics.

Possibly the appendix may be said to occupy a normal position when it lies behind the cæcum, its tip pointing upward and following the usual curve of the intestine. While the base of this rudiment is necessarily fixed, by reason of the tolerably uniform position of the cæcum, its tip is so migratory that no characteristic location can be assigned to it. Almost all the abdominal organs have it for a neighbor at times. In women it frequently assumes the location of a pelvic organ, and thereby gives rise to much diagnostic confusion when these parts become the seat of inflammatory changes. Considering the base of the cæcum as the hub, the appendix radiates like the spokes of a wheel, its length varying quite as much as its location. Its

movements seem to be free save when restricted by the contractions of its mesentery or when it becomes glued to the adjacent tissues by adhesions due to inflammation.

The histological structure of the appendix reveals an attempt at intestinal anatomy which hardly passes the stage of mimicry. The serous coat, continuous with that of the cæcum, is perhaps the least variable part of the structure. In most cases the tube is entirely covered by peritoneum. The muscular layer is very feeble. The sub-mucous layer is generally the most prominent of all. This coat is especially rich in lymphoid tissue. The mucous coat of the appendix lines the lumen of the tube. Between the slightly varying serous and mucous layers lie the two coats in which the greatest histological changes occur. Fibrous tissue is often predominant between the inner and the outer coats, and sometimes obliterates all the layers save the peritoneal.

The blood supply of the appendix is derived from a branch of the ileo-colic artery, which courses along the free border of the meso-appendix. In the absence of a mesentery the vessel will be found beneath the peritoneal coat at the mesenteric border. In women an adventitious twig is sometimes given to the appendix by way of the appendiculo-ovarian ligament.

The lumen of the appendix is lined with mucous membrane and communicates with the cavity of the cæcum. Its diameter approximates that of a 22 caliber rifle shell. It ordinarily contains a slight quantity of mucus and liquid fecal matter, and possibly an appendolith (a semi-solid fecal or chemical concretion which often resembles one of the more familiar fruit seeds.)

In a majority of cases the appendix has a mesentery of its own. This structure is subject to much variation. Many times it extends almost to the tip of the appendix; at other times it

does not go beyond the middle of the tube; frequently it is absent. The appendicular mesentery exerts great influence upon the fortunes of the appendix. Usually it holds considerable quantities of fat between its layers and presents a fringed appearance, but it is often found bent and twisted in curious fashion, the appendix, of course, partaking of its peculiar curves and angles. The appendix is nourished by an artery that courses along the free border of the meso-appendix, and it is therefore apparent that a too sharp contraction of this part not only strangulates the mucous canal of the appendix, but diminishes, or occludes, its blood supply at the same time.

Notwithstanding the rudimentary structure of this little pouch, it manages to conduct its affairs with considerable regard for order unless weakened by disease or over-crowded by appendoliths. It secretes and discharges a small amount of mucus, and expels such substances as may enter its lumen from the cæcum. Its muscular strength is occasionally prominent. In certain cases it has been known to expel its contents after amputation.

The appendix is probably of itself no more liable to disease than other structures, but its chances of recuperation are so small that its pathological margin is a very narrow one. It is beset from within by its own weakness and threatened from without by the contractions of its mesentery. To obstruct its outlet is to inflict a blow from which its recovery is very improbable. It is only by reason of its relations to the general peritoneum that its diseases become important enough to command attention.

CHAPTER II.

Appendicitis.

BY the term appendicitis is meant peritonitis of appendicular origin.

Peritonitis has been described with clinical accuracy from the early days of medicine, but the terms by which it has been known naturally sprung from the mistaken pathological notions concerning its origin. The peritoneum seems to have been regarded with so much terror by the older writers, that its freedom from invasion by the surgeon in the living subject appears to have been equalled only by the silence of the pathologist who explored its recesses after death. Our present conception of peritonitis is far from being the least of blessings conferred upon mankind by the labors of the modern pathologist.

The celebrated Mr. CHARLES BELL¹ records some views, that reveal the dread in which the peritoneum was held by a former generation of surgeons:

“In some of the older writers, we read of operations for undoing knots on the intestines, and other internal causes of obstruction. It has, even in our day, been proposed to cut into the belly of a young gentleman for this laudable purpose; but the good sense and sober judgment of the consultants withstood the ingenuity of the proposer. The mind of the young surgeon is to be put to rest upon this resource of art.”

In his article on strangulated hernia, Mr. BELL, in discuss-

¹ *System of Operative Surgery*, first Am. ed., Hartford, 1812, Vol. I., p. 170.

ing "whether the inflammation of the peritoneum of the general cavity of the abdomen be more apt to follow when the mouth of the sac is cut, than when the cut is carried within one inch of it," informs the student that in cases verified by dissection he found that "the inflammation did not spread from the cut of the mouth of the sac, along the surface of the peritoneum," but "evidently had its origin in the intestine."

It is sneeringly observed, by the same author, that "the operation of gastrotomy [old term for laparotomy] has been more spoken of and recommended by medical writers than by surgeons."

Sir ASTLEY COOPER¹ gives the following directions for closing accidental incised wounds of the abdomen:

"In the treatment of these wounds it is best to make the interrupted sutures; the needle should penetrate the skin and muscles, but not the peritoneum. If the muscle be not included in the ligature, a hernia is sure afterwards to form; and, if the thread is introduced through the peritoneum, it adds much to the danger of abdominal inflammation."

It will be borne in mind that this was the practice of the foremost of living surgeons thirty years after EPHRAIM McDOWELL's first ovariectomy. It would be difficult to adduce a more convincing illustration of the pathological ignorance of the time than that afforded by Sir ASTLEY's injunction.

In a chapter on "Inflammation of the Stomach and Intestines," Sir JOHN PRINGLE² begins at once the consideration of "*ileus* or inflammatory colic." This author rejects the term "*volvulus*" and seems to regard the "*iliac passion*" as some-

¹ *The Lectures on the Principles and Practice of Surgery*, edited by FREDERICK TYRELL, Esq., fifth American from last London edition, Philadelphia, 1839, p. 437.

² *Sir John Pringle's Observations on the Diseases of the Army*, first American edition, with notes by BENJAMIN RUSH, M.D., Philadelphia, 1810, p. 131.

thing apart from the "*ileus verus*" of SYDENHAM. Of the last-named condition Sir JOHN says that he "never saw but one case (the patient died)," and expresses the belief that it is "seldom or never cured." SYDENHAM's confusion of *bilious colic* with *ileus* is strongly opposed for therapeutic reasons. The term peritonitis nowhere appears, but the editor, Dr. RUSH, seems to have recognized the same clinical characteristics throughout all the conditions named, for he adds a footnote, the import of which can hardly be mistaken:

"There would be the same propriety in giving as many names to the rheumatism, as it affects joints, as to give different names of the different diseases of the intestines, from their different seats. This error would be of little consequence did it not lead to a peculiar and different mode of treating diseases according as they were seated in the small or large intestines, or in their internal or external coats."¹

Concerning the causes of "*ileus*," Sir JOHN says that "a few examples may be found of the *ileus* from an inflammation of the *colon*; but I imagine that in most of them, some hardened *fæces*, or some tumour [!] have concurred to straiten the passage and prevent stools." The differences between dysentery and "*ileus*" are clearly recognized, it being remarked that the latter was met with oftener in his practice at home than when he was away with the army.

It is regretful that this illustrious man, who, on June 28, 1750, presented a paper to the Royal Society upon "Experiments upon Septic and Anti-Septic Substances, with Remarks Relating to their Use in the Theory of Medicine," etc., did not pursue the pathological changes of "*ileus*" with the same scientific energy that characterized his study of dysentery.

¹ *Sir John Pringle's Observations on the Diseases of the Army*, first American edition, with notes by BENJAMIN RUSH, M.D., Philadelphia, 1810, p. 133.

After a masterly presentation of the clinical features of peritoneal inflammation, Prof. GEORGE B. WOOD¹ affirms that "it may arise from the ordinary causes of inflammation, such as vicissitudes of temperature, excessive use of stimulating food or drink, suppression of habitual discharges, whether healthy or morbid, retrocession of cutaneous eruptions, and translation of gout or rheumatism. It is, however, more frequently the result of local violence, as of blows, falls, and bruises of all sorts, and of wounds penetrating the peritoneal cavity, including various surgical operations, among which may be mentioned those for strangulated hernia and for tapping, and the Cæsarean section."

As recently as 1879, Prof. SAMUEL D. GROSS,² in an oration that has become historical in medicine, expressed views which at that time were accepted without question by the medical profession throughout the world. He said:

"Moreover, it is not improbable that, in reflecting upon the subject [of ovariectomy], he [McDOWELL] came to the conclusion, *long since universally recognized*, that the peritoneum, *when chronically diseased*, is generally comparatively tolerant of the rudest manipulation, whereas *the slightest exposure of, or interference with, the healthy membrane is sure to be promptly resented, almost invariably, indeed, at the expense of the patient's life.*"

The influence of the vermiform appendix as source of abdominal mischief has been recognized and recorded for more than a generation, but in the absence of precise pathological light the knowledge was of no practical importance. Under the head of

¹ *Practice of Medicine*, sixth edition, Philadelphia, 1868, Vol I., page 851.

² *Memorial Oration in Honor of Ephraim McDowell*, "The Father of Ovariectomy," by SAMUEL D. GROSS, M.D., LL.D., D.C.L., Oxon., delivered at Danville, Kentucky, May 14, 1879. (Italics not in original text.)

"Obstruction of the Bowels," Wood¹ speaks of "the strangulating operation of the *appendicula vermiformis encircling the bowel*," and in referring to the causes of peritonitis the appendix ranks next to the cæcum in producing it, by reason of ulceration and perforation.

NIEMEYER² mentions "ulceration of the vermiform process" among the "exciting causes" of peritonitis.

Peritonitis gradually emerged from the pathological gloom and took its place as a distinct disease, but a knowledge of its essential nature remained a mystery until very recent years. When it was finally unmasked as an infectious inflammation the mysteries of the peritoneal cavity vanished. With a firm reliance in the dictum that "*Filth begets filth*," the appearance of peritonitis now announces to the surgeon that a focus of infection is responsible for the attack.

For clinical purposes peritonitis may be classified as plastic and septic. The former may degenerate into the latter under conditions favorable to its development. Suppurative peritonitis must be regarded merely as a manifestation of the septic variety.

There is some question as to the propriety of regarding the plastic process as true peritonitis, but as the clinical phenomena are practically identical in most cases, in the early stages, it is not feasible to attempt identification at the bedside.

Plastic peritonitis, while essentially protective in aim, may prove fatal from mechanical causes, whereas the septic variety may be so limited that small immediate mischief results.

It must be borne in mind that the peritoneum at times shows

¹ *Practice of Medicine*, sixth edition, Philadelphia, 1868, Vol. I., p. 767.

² *Text Book of Practical Medicine*, New York, 1876, Vol. I., p. 612.

remarkable tolerance of septic elements, and that it frequently disposes of true infection without becoming deeply involved in the destructive process. The vital resistance of the peritoneum must be lowered by some means before the membrane will take up the infection. A mechanical injury opens the way for septic invasion.

The vermiform appendix is more frequently the focus of peritoneal infection than any other part. There are the best of mechanical reasons why this is true. The inherent structural weakness of this rudimentary process renders it an easy victim to the ordinary mishaps of nature, and the peritoneum suffers by reason of contiguity of tissue. The appendix itself can not be regarded as more than a focus of infection.

As known clinically, the phenomena usually denominated appendicitis are neither more nor less than peritonitis. It is the peritoneum that arouses the patient, not the appendix. What is often spoken of as appendicular colic probably arises from the intestine. The peritoneum is an extremely vigilant membrane, and it has under immediate command a powerful array of forces all going to preserve its stability. This tissue is so rich in materials for defense that it pours them out lavishly on an instant's warning. The peritoneum seems to ignore, in a sense, the precise character of the invasion, its unfailing purpose being to surround and destroy all attacks of whatever character. A simple catarrhal inflammation, which is lacking in virulent elements, is promptly met by a vigorous and thorough wall of defense, one that concentrates the energies of the system in its maintenance, whereas a deadly focus of infection may accidentally gain headway and deal a fatal blow without effective resistance. The lower the vitality of the appendix the less likely is the peritoneum to receive timely warning of disaster. It is tolerably good reason-

ing to suppose that a majority of perforations do not take the peritoneum entirely by surprise. Once warned of an outbreak, this resourceful membrane prepares for the worst, and is seldom found to be totally unprepared when its territory is violated. Left to itself and measured by ordinary diagnostic rules, the precise pathology of the appendix in some cases of appendicitis could probably be made out with some accuracy; but the rule of the peritoneum to treat all invasions alike, masks the character of the infection in most cases, so that it defies the most thorough diagnostic guides that human reasoning can frame. It is, in fact, the definite plan of the peritoneum to conceal all minutiae under a grand upheaval in which precision is swallowed up by generalities. Instead of exposing the nature of the invasion, the facts are buried. The peritoneum conceals the field of attack, and the outcome of the struggle is not clear to the bystanders until one of the combatants is in full retreat. Small wonder that the clinical symptoms do not reveal the unknown camp secrets of the opposing side.

It is a vast misfortune for the human race that the term appendicitis ever became fixed in the popular mind. It is totally inconceivable that the utter destruction of this pouch should be attended by an hour's serious discomfort, were it located in assured communication with some reliable drainage canal. If it were suspended inside the cæcum it is doubtful whether it would arouse the small interest that usually attaches to a little hemorrhoid. The name appendicitis is clinically a misnomer, used to designate peritonitis having its origin in the right iliac region. When the ancient conception of peritonitis has been swept away, root and branch, and the teachings of modern pathology shall have supplanted the Providential theory of disease, it may be assumed with some confidence that a term more expres-

sive of the actual condition will be substituted for the one that is now generally employed.

The pathologist has demonstrated the true nature of peritonitis and defined its processes with such accuracy that the surgeon finds it an easy task to walk with confidence, where a generation ago all was confusion and darkness. It is lamentable that a mere focus of infection should have been magnified beyond all reason until it actually confuses pathological study and overshadows the commanding phenomena. It is one of the perplexing mysteries of modern science how a spark dazzles more brilliantly than the stupendous conflagration which it originates, and by which it is soon engulfed.

Logically and clinically, the appendix vermiformis is the spark that fires the temple; no more, no less. Peritonitis is the condition which the physician is summoned to meet, and in no case should he halt between two opinions. Appendicitis of itself, generally, gives no warning, and consequently requires no treatment. The phenomena of peritonitis are nowise different from the phenomena of inflammation in other tissues. The grade may be very mild, involving the smallest area of tissue, yet it is present in some degree whenever an important disturbance is located in this region.

It is a matter of small practical interest to squabble over the species of a little fish that has been swallowed by a larger fish. Human interest and common sense naturally concentrate themselves upon what is present rather than upon what has passed.

CHAPTER III.

Etiology.

IT is only by reason of its bad eminence as the weakest link in the alimentary chain, that the vermiform appendix occupies a position of such commanding pathological importance. If it were an open loop instead of a catchbasin, it is doubtful whether it would be heard from once in a thousand subjects. All its troubles can be traced, in a general way, either to interrupted nutrition or to obstruction of its drainage outlet. Its blood supply is subject to the freakish contractions of its mesentery, and its mechanical proportions are so irregular as to be a constant menace to its integrity. If its caliber were three times what it is, or if its muscular coat were in harmony with the remainder of the intestine, we should hear less of appendicitis.

There is a tendency on the part of this structure to undergo more or less complete fibrosis. If this process proceed in regular order, and the tube slowly become converted into a fibrous cord from tip to base, no harm is likely to befall it. This replacement of muscular by fibrous tissue may arise from the necessities thrust upon the tube by reason of internal pressure, a condition wholly familiar in the urinary bladder in cases of obstruction from prostatic hypertrophy. Wholesome muscular action being wanting, additional strength is demanded to protect the peritoneum from invasion, and hence a fibrous reinforcement is nature's logical response. In cases of irregular deposit of fibrous material, strictures are the most common result. A stricture is a double

menace to the appendix, first by neutralizing the force of muscular contractions and next by obstructing the drainage outlet.

Contraction of the mesentery of the appendix, whereby it is bent at a sharp angle upon itself, is a factor in the production of stricture that must often be taken into account. Some writers assert that this is probably the most frequent cause of an attack of appendicitis. In such cases the distal end of the appendix is ballooned, the muscular coats are greatly thickened, and the mucous lining gives evidences of considerable damage. Perforation often takes place at the angle of the appendix unless the

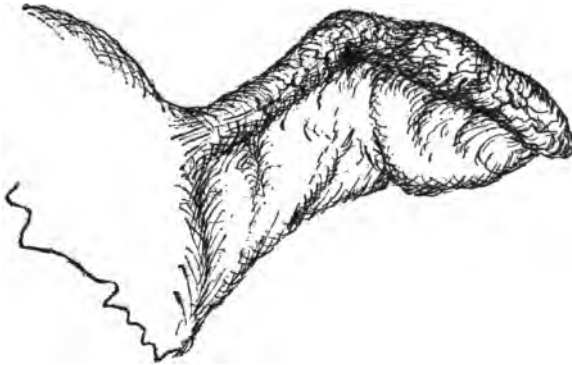


FIG. 1.

Sharp contraction of the meso-appendix, producing an angular stricture of the appendix, and confining an appendolith in the distal end.

condition is relieved by operation. Some doubt the ability of the muscular walls of the appendix to exert appreciable expulsive force, yet the histological structure of the tube seems to be as variable as its location, and in a few cases it is fair to presume that the appendix itself is responsible for what is broadly known as appendicular colic.

The presence of concretions in the appendix is commonly supposed to be a fruitful source of mischief, and no doubt many

inflammatory outbreaks can be traced to them, directly and indirectly, but sometimes no cause whatever can be assigned with certainty. The tube may become entirely gangrenous without giving the slightest clue leading to a detection of the true cause. Clearly necrotic spots are found surrounded by healthy tissue, and extensive areas of ulceration are of frequent occurrence, for which no mechanical cause is apparent. The caliber of the appendix is so small that a minute contraction is a menace out of all proportion to the actual tissue changes.

Age unquestionably exerts considerable influence upon the etiology of this disease. It is rarely found in the extremes of life, before five or after sixty years of age. A few cases, it must be supposed, are not recognized in the very young. After the seventh year it begins to increase in frequency, and is common after the tenth year. Probably it is most often met between the ages of fifteen and thirty-five in both sexes. It becomes rarer after thirty-five, is still less frequent after the fortieth year, becomes something very unusual after fifty, and is met with extreme rarity above the sixtieth year of life. Undoubted cases have been seen in persons who have passed the psalmist's limit, but sufficient testimony of a scientific character is available to warrant the statement that the disease may with tolerable certainty be almost eliminated from the affections of infancy and those of declining years.

The precise influence of sex upon the causes of this disease is not conclusively settled. No doubt this feature has been considerably overdrawn. Trustworthy observers are agreed that more cases are *reported* as occurring in males, but the diagnostic outlines are more obscure in women, in whom the appendix is frequently a pelvic structure, and hence its diseases are liable to be mistaken for some of the ailments peculiar to women. In

the female the appendix receives an occasional arterial reinforcement by way of the appendiculo-ovarian ligament, and this minute spring of nourishment is a factor of decisive importance at times in turning a tide that would otherwise prove destructive. Undoubtedly fewer women die of the trouble, but the fact must be borne in mind that the position of the appendix, when it lies in the pelvis, increases the prospect for a secure protective wall above and insures a readier outlet below, in cases of pus formation. If constipation is as much a factor in the production of appendicitis as it is generally supposed to be, women, who are constipated oftener than men, must be supposed to suffer in a degree corresponding with the increased frequency of this condition in that sex.

The belief is prevalent that traumatism plays a decisive part in the etiology of appendicitis, but it is difficult to see how external violence can do more than provoke a smoldering infection into an active outbreak. It has been observed that the disease is common in persons engaged in vigorous athletic sports, requiring an unusual strain upon the abdominal muscles and particularly upon the psoas and iliacus, but such performances may be regarded as the exciting rather than the remote cause of the trouble.

The influence of micro-organisms in the production of appendicitis possesses a secondary interest only. In no instance has it been demonstrated that these organisms have successfully attacked an uninjured appendix. Their activity in damaged tissues is a matter of scientific record, but the attempt to reconstruct the universe with the germ as the central figure is a conspicuous illustration of what has been called the mistaking of "common-place for common sense." Bacterial growth is dependent upon more or less devitalized tissue arising from mechanical or dynamic causes.

The classification of appendicitis, like the classification of tumors, admits of wide variation and much confusion. Two classifications, the pathological and the clinical, have been most widely adopted, but they have been so blended and confused that no definite practical classification is accepted today. Nor is such a classification possible, for reasons elsewhere presented. It were better to bear clearly in mind the successive stages of inflammation, and the various terminations of this process, and apply them to the appendix precisely as they are applied to other

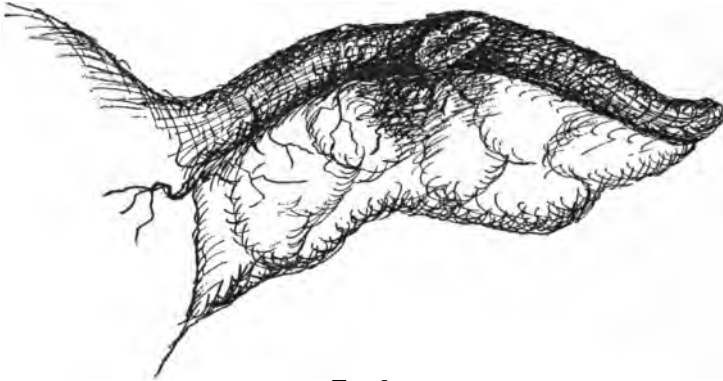


FIG. 2.

Perforation of the appendix on the distal side of a stricture.

structures. The terms catarrhal, ulcerative, gangrenous, perforating, etc., are simply descriptive of certain degrees and terminations of the inflammatory process. The *tendency* of inflammation here is, for sound reasons, from the benign to the malignant. An ordinary catarrhal inflammation of the appendix that would subside spontaneously within a few hours soon becomes a deadly menace, by reason of the swollen mucous coat closing around a concretion, thus occluding the drainage outlet and rendering the putrefaction of retained secretions a practical certainty. Here the danger arises from obstruction to the disposal of effete

matter; if the strangulation of the tube is complete, its nutrition ceases, and gangrene is ordinarily the only possible outcome. The peritoneum, however, is so resourceful that it sometimes nourishes an otherwise doomed appendix through the medium of adhesions. The two-fold dangers to the appendix should always be borne in mind when the frequency of appendicitis is under consideration.

The low vitality of the appendix is a factor of extraordinary danger. Feebly nourished, poorly supplied with nerves, as it is in many instances, its destruction can proceed without substantial disturbance until an unsuspecting peritoneum is penetrated by a deadly force which threatens it with destruction. The peritoneum is an acute sentinel and a marvelously energetic combatant under open conditions of warfare, but its singular demoralization and inactivity in certain cases of surprise resemble the stupid inertia of an army aroused from slumber by a sudden charge of cavalry. The infection either strikes at a point where limiting adhesions are impracticable or its virulence is such that the system is overwhelmed before the forces of resistance can be properly aroused.

The higher the vitality of the appendix the greater the protection to the patient, for then the appendix, in the first place, offers more definite resistance to whatever threatens its integrity, and in the next place the peritoneum is more certain to receive timely warning of a possible injury to itself.

The influence of foreign bodies in causing appendicitis has been greatly magnified by sensationalism. No doubt a fruit seed might spread mischief in an already diseased appendix, but in nearly all cases where familiar seeds are reported as having been the cause of perforation in the walls of the appendix it is safe to conclude that an appendolith, and not a fruit pit, was the substance

at fault. The fact that abundant quantities of fine seeds are found in the *debris* of peritoneal abscesses is easily explained on the ground that such substances can readily pass through a perforation and mingle with the fluids of an abscess. This circumstance by no means connects them with the cause of the trouble. The direct entrance of a foreign substance into a normal appendix is a circumstance of extreme rarity. In any such event the probabilities favor its expulsion without material damage to the tissues.

CHAPTER IV.

Diagnosis.

THE most constant and characteristic symptoms of appendicitis are sudden pain in the epigastrium, vomiting, elevation of temperature, rapid pulse, moderate bloating, and pronounced muscular tension of the right side of the abdomen.

While this array of symptoms is practically conclusive, it is necessary to remember that individual variations are not rare.

An appendix may degenerate into a mass of gangrene without producing symptoms serious enough to take the patient from his business. Rupture into the peritoneal cavity necessarily takes place, and then there is usually a sudden spurt of pain; but it is astonishing to find how little pain such a calamity produces in certain cases, even when the symptoms of shock are pronounced. A gangrenous tube can hardly be painful, and the surrounding tissues are not yet sufficiently infected, or are already too benumbed by sepsis, to respond with characteristic pain upon pressure.

The epigastric pain is reflex only; the real seat of the lesion can be ascertained only upon manual examination of the abdomen. In most cases the precise point of highest sensitiveness can be located slightly below an imaginary line leading from the navel to the anterior superior iliac spine, and somewhat nearer the latter point than the former, as shown in Fig. 3. Occasional variations must be borne in mind. Sometimes this point will be found to lie considerably lower than the imaginary line, even

approaching the pelvic brim, and may lead to considerable confusion in the case of women who are suspected to be suffering from inflammation of the uterine appendages. This difference, however, should be remembered; if the pain arise from the appendix the sensitiveness will be more pronounced from press-



FIG. 3.

The cross indicates approximately the point of highest sensitiveness in acute appendicitis.

ure over the abdomen than it is in the pelvis, as determined by vaginal and rectal exploration.

Vomiting is nearly always present in every attack of appendicitis at some stage of its progress; generally it will be found at first, when it may be beneficial in clearing an overloaded stomach.

In the later stages of the disease persistent vomiting is a very dangerous signal, frequently denoting intestinal obstruction.

It is important carefully to measure the degree of abdominal tension, since this condition is not so prominent in inflammatory diseases of the pelvic organs in women.

The treacherous behavior of the pulse and the temperature in appendicitis is one of the most singular, and at the same time one of the most startling, features of this malady. The temperature is so meaningless that it must not at any time be the decisive point in forming a proper estimate of the patient's condition. A few hours after the onset the pulse and the temperature will generally be found near the hundred mark, and either, or both, may be very much higher than this. Within twenty-four hours both may return nearly to the normal, or may remain stationarily high, or mark a slow but progressive rise. The pulse frequently falls below 80 in the face of the most fatal conditions, the temperature either accompanying it, or pursuing a flickering and aimless course of its own. A consideration of both these elements belongs to prognosis rather than to diagnosis.

Beyond the mere facial distress common to all suffering, the facial lines are of small account until there is a development of conditions that seriously threaten life.

A history of constipation will generally be found, but no great importance can be attached to this symptom when it is known that appendicitis frequently occurs in persons whose bowel movements are perfectly regular. The onset is occasionally marked by a few liquid passages.

Appendicitis is frequently mistaken for other diseases and is often not recognized at all.

It is confounded with *typhoid*, and the two diseases may, indeed, exist coincidentally in rare instances, yet the lines between

them are ordinarily so clear that mistakes ought to be almost out of the question. Typhoid has a sluggish onset, appendicitis a sudden onset; in typhoid the right iliac region is slightly sore, in appendicitis it is acutely *sensitive*; typhoid has a tolerably uniform pulse and temperature wave, appendicitis has not; in typhoid the height of the fever bears a somewhat definite relation to the violence of the attack, in appendicitis there is no such relation; typhoid begins with diarrhœa, appendicitis is preceded by constipation; typhoid patients complain of prostration, appendicitis patients complain of pain; rose-colored spots are frequent in the early stages of typhoid; they rarely appear in appendicitis, and then only in the last stages; typhoid lies quietly in bed, appendicitis seeks a frequent change of position; typhoid lies flat upon the back, appendicitis presents the characteristic flexing of the thigh upon the abdomen. Between certain forms of fulminating appendicitis and intestinal perforation resulting from the rarer types of typhoid no distinction is possible from the symptoms.¹ Fortunately there can be little question in either condition concerning the method of treatment, or the time when such treatment should be instituted.

The inflammatory diseases of the uterine appendages are at times confused with, and in certain instances may defy actual differentiation from, appendicitis. In this connection the migratory habits of the tip of the appendix should be remembered. The base of this tube, however, occupies a tolerably fixed position, and the characteristic pain, if located *above* an imaginary line drawn from spine to spine of the two iliac bones, is almost certainly of appendicular origin. Vaginal and rectal exploration should always

¹ See *An Object Lesson in the Diagnosis of Appendicitis*, by J. E. SUMMERS, Jr., M.D., Omaha, Nebraska; *New England Medical Monthly*, June, 1897.

be made in cases of uncertainty, but the land-marks between an inflammation of the Fallopian tube and an outbreak of appendicitis, when these structures are adherent to each other from plastic exudates, are so shadowy that no practical reliance can be placed in them. The appendix is frequently found in the female pelvis, and it is as liable to set up trouble there as it is anywhere. Doubtless many cases of "ovarian abscess" are nothing more than the breaking of appendicular abscesses through the vagina. It may well be questioned whether appendicitis is more common in men than it is in women. The probability is that much remains to be learned of the relation of the appendix to the etiology of pelvic abscesses. The history of the case should be considered in the light of modern pathology. If the woman presents a history of endometritis, the presumption is that she may be affected with tubal disease, but this would not exclude a simultaneous attack of appendicitis. One symptom is here of great diagnostic value; it is the degree of muscular tension found especially in the right rectus muscle; in appendicitis this is very pronounced, whereas in pelvic diseases it is absent or less decided. In the case of the left tube less difficulty is presented, and a history of disease on the left side would strengthen a belief in the existence of inflammation in the right tube.

The rupture of a Fallopian tube resulting from extra-uterine pregnancy should be differentiated by the exercise of moderate diagnostic skill. The pallor, the sudden collapse, the blanched lips and colorless cheeks, the thirst, are unmistakable signs of hemorrhage, and even if the diagnosis is not positively clear there can be no shadow of doubt as to the proper treatment. No matter whether the uterus is positively known to have given off shreds of decidual membrane or not, any such case demands immediate operation and radical treatment.

Acute Intestinal Obstruction is characterized by total absence of bowel movements, save what may be discharged below the seat of trouble; incessant vomiting, growing in violence as the intestinal occlusion approaches the stomach; paroxysmal pain, and nearly normal pulse and temperature at the outset. The onset of appendicitis is usually marked by a sudden rise in pulse and temperature, and the vomiting is less violent. The appendix itself may cause obstruction of the bowel, a fact which must not be forgotten when complications arise during an attack of appendicitis, but here again the symptoms presented call for prompt treatment rather than for a finely drawn diagnostic picture.

Acute Intussusception is frequently characterized by the passage of blood or mucus, and many times by the presence in the rectum of the telescoped intestine. More rarely the classical "sausage-like tumor" can be made out by abdominal palpation. This disease, however, very largely belongs to infancy. In GIBSON'S exhaustive study of the subject,¹ he found that out of 239 cases it occurred 105 times in infants under one year of age, only 21 of them being females; and 156 times out of the same number of cases in patients of ten years and under. From this it appears that only 83 cases out of the entire number had passed the tenth year of life. While not literally true, it may be said that in two-thirds of the cases appendicitis does not begin until intussusception has left off.

Renal Colic attacks a patient without warning and becomes violent within a moment. Pain follows the course of the ureter into the pelvis; the urine may be bloody or diminished; the thigh is flexed but muscular tension is less pronounced than it is in appendicitis, and the testicle is sharply retracted. Irritation of the bladder is generally well marked.

¹ *Medical Record*, July 17, 1897.

The unsettled location of the tip of the appendix must always be kept in mind. Left-sided appendicitis is found at times,¹ and the precise point of greatest tenderness, if in an unusual situation, should not be given undue weight if the remaining characteristic symptoms are clearly defined.

Coincident sensitiveness in other regions is met with in some cases, and might prove misleading, unless proper care be exercised in conducting the examination. Excepting the pelvis in women, no great difficulty is presented in other parts in ordinary cases in arriving at a conclusion safe enough for purposes of treatment.

It is of course, impracticable, if not impossible, to outline all the conditions for which appendicitis may be mistaken, but the exercise of due care in examinations will nearly always reveal the proper diagnosis, or at least point out the correct treatment. Typhlitis and perityphlitis are rare at best, and their practical differentiation from appendicitis is probably impossible. It may well be questioned whether, apart from certain independent ulcerations of the cæcal mucosa, such conditions exist in the absence of appendicular disease. It would be a matter of great interest to find the record of such a case in a person certainly known to be without an appendix.

It is the *group of symptoms*—the *sudden* onset of pain, the vomiting, the accelerated pulse, the few degrees of fever, the iliac sensitiveness, the cæcal resonance, the tense right rectus muscle, the constipation—taken together that form the unmistakable picture of appendicitis. One symptom may overshadow the others, in either a diagnostic or a prognostic sense, and may be nearly conclusive, but the outcropping of other symptoms goes to complete and strengthen the portrait.

¹ See article by GEORGE R. FOWLER, M. D., Brooklyn, in *The Medical News*, Philadelphia, Nov. 25, 1893.

Every suspected case of appendicitis must be subjected to *a systematic and thorough examination*. None of these cases can safely be passed over in a heedless fashion. In no case must the prejudices of the patient be allowed to influence the practitioner. The abdomen should be subjected to a complete manual examination. Gentle but decisive pressure must be made over the stomach, the spleen, the liver, the gall-bladder, the flexures of the colon, and particularly over the right iliac region. The vermiform appendix can frequently be palpated by one of ripe experience, but the procedure is not always free from risk, and is rarely of practical value. An inflammatory "tumor" must not be rudely examined. Some abscesses are protected by extremely frail walls, which must on no account be broken save in the proper surgical manner.

It is rare that an examination conducted with systematic care will fail to reveal appendicitis, if it is present, within a few hours of its onset.

CHAPTER V.

Prognosis.

THE prognosis in appendicitis must always be guarded. It is a most deceptive and treacherous disease. The precise pathology is not revealed by the clinical symptoms. A normal pulse means nothing definite; a rapid pulse, especially during the first hours of an attack, is not indicative of an unfavorable outcome. The most painful cases are not necessarily the most dangerous, nor are the least painful ones to be passed over as favorable. Often the degree of pain is out of all proportion to the danger of the attack. The sudden subsidence of pain, or its quick reappearance, are symptoms that are full of danger. Rapid shifting of pain is also a significant indication, which means no good thing for the patient. Distention is always present in some degree, but extreme distention is distinctly unfavorable. Vomiting is generally present during the early hours of an attack, but unless persistent is not of especial prognostic value. Incessant empty retching is exceedingly unfavorable, and if accompanied by extreme bloating and a pulse beyond 120, almost certainly indicates a fatal issue. When it is found that a pint of foul pus can be diffused over the abdominal contents and remain for hours without sending the temperature higher than 99°, the uselessness of the thermometer in this disease may be judged. While it is true that a rapid pulse and a high temperature are ordinarily associated with destructive processes, a low pulse and nearly normal temperature

often mask a fatal condition until too late to save the patient. The appearance of shock at any stage of appendicitis means either perforation of the appendix or the rupture of an abscess into the free peritoneal cavity; in any event, it is a symptom of the deepest significance and its presence must not go unheeded a moment. At times the outlines of shock are so delicate that they are apt to be undetected, and violent symptoms of shock are very rare.

In primary attacks the mortality is lowest and the prognosis most favorable. Where the inflammatory process is purely prophylactic, and not destructive, the attack should be on the decline by the third day; that is to say, the pulse should be nearly normal, the iliac tenderness should be slowly declining, the appetite returning, the bloating much diminished, the muscular tension reduced, and the facial lines indicative of comparative comfort of body and peace of mind. Such cases are in all probability progressing toward recovery, although the local tenderness may linger for a week or even longer. A secondary outbreak is in the nature of things more to be feared than the primary; the mortality is higher, and the probabilities of safe recovery are less than in the former attack. It may be said that the danger in appendicitis increases with the number of succeeding attacks; that more will die from a secondary attack than from a primary attack, but not twice as many; that more will die in the third attack than in the previous attacks, but not many more. It is by no means certain that the time elapsing between attacks is indicative of the danger of a given outbreak. One patient will have three spells of appendicitis in as many months, with a slightly damaged appendix; another patient will remain well for eleven years and then die in sixty hours from fulminating appendicitis.

The violence of the onset is not a safe guide in estimating the patient's prospects of recovery. In some extremely violent

attacks the prophylactic work of the peritoneum is most thorough, and the limiting wall of adhesions will be found sufficient to confine the infectious material within comparatively safe quarters. On the other hand, some apparently trivial attacks are beyond the resources of medical art before their gravity is recognized. Especially is this true of patients between the ages of five and fifteen years. A vigorous boy of ten complains of slight gastric distress and loss of appetite, to which no attention is paid. In two weeks, without warning, a gangrenous appendix fulminates and scatters infection all over the peritoneum. Careful examination would, no doubt, have revealed the condition in good season, but such patients are not sick enough to require the services of a physician and are generally neglected, or are treated by domestic remedies, until the symptoms of diffuse peritonitis indicate that the chances of life are gone.

Diarrhoea at the outset of a sudden attack, is sometimes indicative of general peritoneal infection.

The abscess cases are so variable that it is difficult to form an accurate opinion concerning them. Where the probabilities indicate a solitary abscess, occupying a snug corner well confined from the free peritoneal cavity, recovery is the rule if an operation is promptly performed and thorough drainage established. If the case has lasted for weeks and the patient does not promptly improve after the complete drainage of an abscess, it may be suspected that secondary accumulations of pus exist in the abdomen, and the outcome is not promising. Vomiting, late in an abscess case, probably denotes that an obstruction of the gut has taken place from pressure of the abscess wall or from the tightening of an omental fold. The outlook is desperate.

A chill during an attack of this disease is an unfailing sign of pus. The pus may be taken care of, that is to say walled off,

by the peritoneum, or it may be the starting point of diffuse, and therefore fatal, peritonitis. The chill is not generally severe, and may at times be so mild as to deceive the patient and confuse the physician. While it is true that the chill itself is not conclusive as differentiating between localized and diffused peritonitis, it is wholly reasonable to proceed upon the belief that a sharp and prolonged chill denotes greater danger to life than one less pronounced. A succession of chills means increasing complications.

It would seem unnecessary to say that the prognosis is always influenced by the age, the surroundings, and the personal habits of the patient.

Between the ages of five and twenty years the natural defenses are extremely aggressive, and, other things being equal, such patients make the best records for recovery.

Statistical records are of no value in a given case; it is pretty well established that seven out of eight primary cases recover, but it is generally impossible in the early hours of any particular attack to tell what course it will take. The determining factor in every case, of course, is the extent of the injury to the peritoneum, and this cannot be determined with accuracy, even upon careful operative inspection.

The behavior of the peritoneum after infection depends more upon the virulence of the infection than upon its extent. A tiny focus of infection will start a general and fatal conflagration in one case, whereas a purulent saturation will fail to do mischief in another. The vital tone of the patient is a factor of first importance, and this may at times be very misleading. A patient who would be swept away by a moderate attack of pneumonia can hardly be expected to offer much resistance to abdominal lesions.

In the following summary the symptoms of appendicitis are considered solely with reference to their prognostic value:

Pain. Neither intense pain nor slight pain is conclusive concerning character of inflammation, whether plastic or septic; sudden disappearance, or reappearance, or shifting, indicates presence or imminence of perforation, but tells nothing as to extent of infection; a gradual decline is favorable, if pulse, temperature, bloating, and facial lines are in accord.

Vomiting. Not unfavorable in the early stages; if prolonged and violent, obstruction of the intestine is more than likely, and is then extremely unfavorable.

Temperature. Of little value save in extremes; occasionally sub-normal in early morning in clean operations; may be normal in gangrene; very high in certain cases where limiting adhesions are well constructed; must be given small weight apart from associated symptoms.

Pulse. May be normal in gangrene of appendix and when intestines are flooded with pus; if moderately high denotes probable destructive inflammation, but affords no clue to the security of the natural defenses; practically of small value before operation; *after operation*, it becomes the chief of prognostic indications; if between 80 and 100, with slight variations, the outlook is favorable; if higher, and rising, denotes advancing sepsis.

Facial Expression. Of small value before the development of threatening conditions; if distinctly and clearly marked, perforation may confidently be expected.

Shock. Always a grave and threatening symptom; indicates perforation of appendix, or cæcum, or rupture of circumscribed abscess into the free peritoneal cavity.

Chill. Means in a word, *pus*, but shows nothing as to its location or extent; if very violent and prolonged, perforation into free peritoneal cavity is more than probable; if repeated, discloses the spread of complications.

Bloating. Always found, but is not a conclusive sign unless extreme, where intestinal paralysis from diffuse infection is present.

The cases most certain to make rapid, safe, and lasting recoveries are those in which the clean, precise and effective resources of modern science are substituted, at the earliest possible moment, for the clumsy, dangerous and uncertain methods of nature.

The prognosis of a case clearly depending upon the character and the extent of the field of infection, and this field being hidden under a bushel, a guess under such circumstances can hardly be entitled to much respect. It savors too closely of deciding a case upon hearing the testimony of one side of it. Groping in the dark may at times be unavoidable, but it can never be upheld as superior to the teachings of scientific knowledge.

Regardless of the bitter conflicts of opinion concerning the treatment of appendicitis, the pathologist has settled for all time the fact that the death rate depends almost wholly upon sepsis. Other factors are largely incidental and accidental. It is therefore evident, without discussing an endless array of contingencies, that ultimate results of treatment depend, first, upon the efficiency of the natural defenses for limiting infection, and, second, upon the resources of art in dealing with it.

In concluding the subject of prognosis, no rules can be given that will take the place of the acute instinct of an experienced and cautious clinician, who reads between the lines of suffering, as a thoughtful observer reads between the lines of human conduct.

CHAPTER VI.

Indications for Treatment.

APPENDICITIS is a surgical disease. That a great majority of primary cases recover without operation, has no logical bearing upon the essential nature of the affection. Comparatively few fractures require direct operative interference, yet no one questions that all fractures are of themselves surgical lesions. Pleuritis is at times a surgical disease, but only incidentally so. The nature of a disease is something entirely apart from the application of treatment to it. Strabismus is a surgical condition, regardless of whether the patient is operated upon early in life or whether he carries the trouble to the grave with him in his eightieth year.

It is important at the outset, for the practitioner clearly to understand the precise character of the disease he is treating. He will thus appreciate more fully the practical bearing of certain procedures which all prudent surgeons recognize as being essential in all cases of appendicitis.

It is fortunate in this disease that its purely therapeutic treatment is rendered more helpful and successful by the employment of means demanded by the rules of surgical practice. Pain is often a source of great annoyance to the therapist. A purely medical view might permit the use of morphine by one who believes in palliation. From the surgical standpoint its employment is utterly condemned, the pain being in a large degree relieved by the thorough evacuation of the alimentary

canal, a procedure required by a knowledge of the real character of the complaint.

Perhaps the most rational and humane view is to exclude all controversial matters from the mind and to regard every case as presenting the solitary problem of a patient to be cured. This at once places all the resources of the healing art in the hands of an impartial judge who has a single purpose before him.

The pathologist has decided that appendicitis belongs to surgical diseases, and has given the reasons why the assignment has been made. A case is as much surgical in the first hour as it is in the last hour of an attack. It is not surgical for the reason that medicine has failed, any more than a compound fracture is medical because surgery has failed. The operative treatment of a mangled limb belongs to surgery, regardless of whether the patient is saved or not.

The statement is repeated that appendicitis is always a surgical disease. The resources of surgery are very large. Surgical treatment is no more restricted to the use of instruments than medicine is bounded by the employment of drugs. By carrying out the principles of surgical treatment, fewer cases will imperatively demand the knife. The surgical program ignores the confusing general symptoms upon which medical treatment is necessarily based, and proceeds upon the established truths of pathology. Medicine, strictly applied, assumes that perforation will not occur; surgery goes upon the theory that all cases may end in perforation, and that the patient should, under all circumstances, be in what may be called the surgical condition. From this line of reasoning come the rigid confinement to bed, the restricted diet, and the complete evacuation of the intestinal canal—just the measures most likely to render operative interference unnecessary.

It would be an impossible task to harmonize the conflicting opinions of to-day concerning the treatment of this disease. The discrepancies in personal experience are notorious, yet personal experience is a factor of such importance in human affairs that it can hardly be ignored in justice to all concerned. It may not be scientific for a practitioner to be guided by his experience in five cases, but it is thoroughly human. The greatest confusion arises by reason of the failure to classify cases according to some definite standard. To treat a score of cases without a death conveys no useful meaning unless the cases are grouped according to the pathological changes present. Much of the controversy upon the subject of treatment is so puerile and illogical that it is a waste of time to consider it.

There seems to be no doubt, however, that the drift of medical opinion is steadily toward reasonable operative measures as offering the most favorable results. The surgical nature of the trouble is not longer seriously disputed by scientific men, the only difficulty being to decide the proper moment for the institution of operative procedures.

GOODNO says:¹ "In the management of a case of appendicitis the first question to arise is that of the advisability of operation since, notwithstanding the very large percentage of recoveries under medical treatment, any case, however mild, may at any time present strong indications for immediate resort to the surgeon's knife. My personal views upon the operative treatment of appendicitis have recently undergone considerable change as the result of careful investigation of the subject, having had the opportunity of observing an unusually large number of operated and unoperated cases during the past year. There can be no doubt but that we physicians have been occupying too conservative a position

¹ *Practice of Medicine*, Philadelphia, 1895, Vol. II., p. 657.

respecting operative interference in these cases, based upon results in its treatment. * * * If at the end of twenty-four or forty-eight hours there has been no abatement of symptoms, and the pain especially, is no better, an operation is generally called for. Increased tenderness and tympany make the demand for operation imperative."

It will be observed that Prof. GOODNO lays particular emphasis upon an increase in the pain as calling for operative relief; but the sudden subsidence of pain, or its change of position, are expressions of equal or greater value.

TYSON is no less pronounced in his views upon the question of treatment. He says:¹

"As soon as the diagnosis of appendicitis is established, indeed, pending its settlement, a competent surgeon should be associated with the physician, for the reason that in the vast majority of cases operative treatment is sooner or later demanded, while the hour for such interference is best settled by daily conference. The course of cases of appendicitis is often very delusive, and the surgeon who operates frequently is likely to have seen more cases than the physician. The diagnosis being established, operative treatment should be recommended, except in those cases where the disease is so far advanced as to make it unlikely that the patient will be saved by operation. My reason for this belief is, that while a majority of cases of simple appendicitis may subside with rest, in a very large number, at least one fourth, the primary attack leaves the patient predisposed to another at once more severe and dangerous than the first, while we have no guarantee that any attack will subside without suppuration, or, what is worse, without leaving the condition referred

¹ *The Practice of Medicine*, Philadelphia, 1897, p. 306.

to, in which malignant inflammation or perforation may set in at any moment without warning.

"It must be admitted that it is not always easy to lay down a rule by which operation shall be determined, for it is not only that we must know when to operate to save life, but also that we must know when not to operate in cases so severe that operation will be futile, and it is due the operation that it should be saved the opprobrium of such futility. Certain it is, too, that in cases where operation is of no avail, death will be hastened by it, the depressing effect of etherization co-operating to hasten the fatal end. Much difficulty is, however, removed when we decide to operate, *without undue haste*, in all cases so soon as the diagnosis is established, except where operation will evidently be futile. I say without undue haste, for, in many cases, it is plain that a few days' delay, if the patient is kept at rest, will make no difference in the result, while, if the inflammation is subsiding, a stage is being reached in which the operation is even less dangerous, since the united experience of surgeons goes to show that the mortality of operations between attacks is practically *nil*, while that immediately succeeding diagnosis in ordinary cases is nearly so. There can be no doubt, moreover, that excision of the appendix *after* a first attack is a safer procedure than *during* a first or any attack. Even where suppuration has set in, it may be safe to delay operation for a day or two while the patient is held quiescent.

"When, on the other hand, shall operation be omitted because it must be followed by a result inevitably fatal? In all cases where there is diffuse septic peritonitis, rapid pulse and leaky skin, constant vomiting and constipation, operation is generally futile. In such cases saline purgatives and stimulants, diffusible and cardiac, are indicated, and rarely, though rarely indeed, recoveries have taken place."

The precise moment for the institution of operative measures is very far from being settled, save in those cases where the symptoms are so threatening that delay clearly means the death of the patient. The fiercest controversy has raged over the supposedly clean cases—the very ones which it is universally admitted make the best recoveries. There is no doubt whatever that the death rate from nonseptic cases is a very low one, and that it is appallingly high in those in which the invasion has got beyond the resources of surgery, but these facts seem to have intensified the struggle concerning the exact time when operation should be performed. Even where the presence of pus is undoubted there are wholly divergent opinions as to when it should be evacuated. Some maintain that the sooner it is removed the better, whereas others insist that nature should be given time to perfect the abscess wall. Mr. TREVES¹ thinks that operation is seldom imperative before the fifth day.

The plea for delay in cases of circumscribed abscess is based upon the theory that the abscess wall will become firmer with waiting. While this may be true generally, there is no guarantee whatever that such will be the result in any given case. It is astonishing many times to find how frail a wall lies between the free peritoneum and a collection of foul pus; a wall as thin as tissue paper, which a single spell of vomiting or coughing would break down in a moment. There is no more certainty that the peritoneum will take care of the contents of the appendix than that the appendix itself will; in other words, a spreading infection is just as probable after perforation as perforation itself is probable in any case. Perforation is not the rule, neither is diffuse peritonitis, but there is nothing whatever in mere delay that renders either more improbable. The peritoneum always has a plan of

¹ *British Medical Journal*, October 31, 1896.

defense against all attacks regardless of their virulence, but it has nowhere been demonstrated that this plan is less liable to collapse one day than another. A firm wall has been found surrounding an abscess on the third day; a supposedly secure wall has broken down without warning on the sixth day. There is no dispute concerning the fact that most walls do grow more secure with time, but just how this admission is to throw light upon the case in hand does not appear. A mortality table is correct when applied to a thousand persons, but its conclusions have small value when applied to an individual life.

The following propositions are advanced by Dr. GEORGE F. SHRADY:¹

"1. The continuously frequent or progressively accelerated pulse rate is of itself a prime indication for operation.

"2. Pain, localized and progressive, is a valuable associated condition. When pain is sudden, severe and progressive, and accompanied with chill, it means perforation or abscess rupture and immediate operation.

"3. Increase of temperature is third in importance, but when associated with one or more of the previous symptoms, and more especially with increase of pulse rate, it makes immediate operation a foregone conclusion.

"4. The gradual subsidence of the three cardinal symptoms—pulse rate, pain and temperature—is a legitimate reason for postponing immediate operative interference.

"5. In cases of abscess it is generally safer, while watching for urgent indications, to wait until adhesions have formed a sufficiently protective wall.

"6. In cases of recovery after mild attacks, and without operation, we are never sure of recurrence until the latter takes

¹ *Medical Record*, January 9, 1897.

place, when the operation can be done soon enough, and, all other circumstances being equal, preferably in the interval of a succeeding attack and when the tissues are not in an inflamed condition."

Dr. SHRADY's masterly summary is likely to stand as a model of concise thought and accurate expression. The first four propositions are beyond criticism. The conclusion expressed in the fifth may be altered with the increasing experience of the profession, although it is true, as has been stated, that protective adhesions *generally* became more secure with delay. The last paragraph embodies practical wisdom of the highest order. There is no sound reason why an uninflamed appendix should be removed simply because it has once been inflamed. It is not denied that a recurrence is quite probable, but nothing short of actual recurrence will justify the operation, which should be performed without a moment's delay as soon as the diagnosis is established. To wait for a second subsidence may sacrifice the patient, and is far more risky than it is to do a so-called "interval" operation. The theory that an abdomen should be invaded simply because it has been the seat of disease no longer present can hardly be justified by any rational principle of surgery. An appendix that has survived an inflammatory attack must be held to be surgically innocent until undoubted evidence exists that it has broken the peace. It should then be dealt with as promptly and as radically as any other chronic malefactor. The patient who has survived three attacks may calculate with some confidence upon having a fourth, but he may be inclined to inquire with some spirit why, if a fourth attack is to be dreaded, he was allowed to pass the third without operation?

It is not for a moment denied that the condition of the person who has had one attack of appendicitis, and has not had the

appendix removed, is a very unenviable one. The life insurance companies will not assume the risk, and the occupation of the patient may take him far away from skillful medical attendance. Notwithstanding all this, operation, as a general rule of practice in such cases, cannot be endorsed. In exceptional instances it might, of course, be wholly proper to operate, but this is not the rule.

Some published advice touching the management of what is called "chronic relapsing appendicitis" is very difficult of comprehension in the light of the clinical history of the disease. One well-known surgeon advises operation when "the attacks have been very numerous;" "when the attacks are increasing in frequency and severity," "when the constant relapses have reduced the patient to the condition of a chronic invalid," and especially when "the last attack has been so severe as to place the patient's life in considerable danger." Just how much danger of this sort does the ordinary patient relish? And if one attack that "places the patient's life in considerable danger" is a logical excuse for operating upon him when he is well, would not three or four dangerous attacks constitute a much stronger reason for the same procedure? Having survived four attacks, does it follow that he will escape with his life from the succeeding dozen?

The same rules should apply to patients in whom appendicular abscesses have been drained. It is generally impossible to locate the appendix at such times or to ascertain its condition with safety, and the question whether a secondary operation in clean tissues is justifiable will naturally be presented for solution. No doubt an appendix sometimes emerges from an abscess wall with trivial damage to itself, and hence capable of a repetition of its former mischief, for the probabilities of a subsequent attack of appendicitis are certainly stronger where pus has not formed

than when it has. It is safe to assume, however, in a large majority of such cases that the appendix has been so far destroyed that it will not again threaten life. Should a secondary operation be decided upon for exceptional reasons, it should be postponed as long as practicable, and certainly until all symptoms of sepsis have vanished.

Persistent pain, even of such moderate intensity as not to take the patient from the pursuit of his vocation, is frequently a sufficient cause for advising the removal of the appendix. Such cases are more to be dreaded than those in which the pain is acute. A careful and somewhat elaborate investigation of the subject of fulminating appendicitis leads to the conclusion that it is often preceded by symptoms of such mildness that a physician is not summoned until the evidences of shock from perforation are present. In any case of smoldering pain in the right iliac region it may be suspected that some serious if not fatal organic lesion has befallen the appendix, and those who dwell upon the astonishing results of operations *after* an attack has subsided will find an engaging field for the exercise of their talents in demonstrating the still more remarkable success of operations *before* this magazine of sepsis has exploded and scattered infection beyond the resources of surgical art. Due caution should be exercised in making a diagnosis, but the fact having been established beyond reasonable doubt that an incurable and constant pain is due to the vermiform appendix, it should be removed without the slightest hesitation. The same surgical principles that apply to mammary carcinoma might, with some propriety, be applied to the vermiform appendix, yet the astonishing fact remains that surgeons who perform the "complete" operation for removal of the breast upon the least suspicion, because they dread a spread of infiltration, will oppose vigorously

perfectly legitimate efforts to apply the same principles in the right iliac region.

It is difficult to justify on sound pathological grounds more than reasonable delay in operating as soon as a diagnosis is made. The greatest number of lives are saved by pursuing a course that deals with infection in a straightforward manner. If perforation is forestalled so much the better. It is always better to prevent it than it is to risk the dangers of dealing with it. An operation during the first day has positive advantages of great value in its favor. In cases where high skill is not accessible the inexperienced operator should remember that his chances of success, and his patient's chances of life, are greater as the complications are fewer. If the case demands drainage on the first day, it will demand more drainage on the fifth day. Few cases do demand drainage if operated upon in the first hours of the attack, and this is an important consideration, since it is undoubtedly a factor of some consequence in the death rate. The recoveries are more numerous, the days spent in bed are fewer, the complications are rarer when no drainage is required. In nearly all early cases the appendix can be located and removed, and a possibility of recurrence settled for all time. To wait for dangerous symptoms, when operation is confessedly imperative, is to trifle needlessly with dangerous elements. In a disease of such treacherous character the patient should be given the benefit of every doubt. There may be organic lesions in other parts which may well cause a conscientious man to dread to perform an operation of any kind, but these conditions are never rendered less dangerous by a spreading peritoneal infection. Certainly a threatened escape of gangrenous matter into the peritoneal cavity is a pathological condition that rises to the first magnitude.

Prof. TYSON has formulated the logic of the situation with admirable clearness when he advises operation, without undue haste, in *all* cases as soon as the diagnosis is established, except in evidently advanced cases of diffuse peritonitis, where all measures are alike futile. GOODNO, with certain qualifications touching the skill of the operator, might be said to occupy the same ground. He says:¹

"We are not in possession of any positive data by which we can certainly recognize the dangerous cases in the early stage, when it is of the highest importance that such recognition should take place. Were it possible to diagnosticate the pathological changes present in a given case, there would be no difficulty in framing a prognosis and defining a treatment. But this we cannot do. Prompt surgical interference gives very favorable results. Some operators have gone to the extent of saying that the dangers of the operation are practically *nil*. This may be true of finished operators of large experience, but it does not apply to the average surgeon whose experience in these cases is necessarily limited."

The operation performed in advance of peritoneal sepsis has, in skillful hands, yielded extremely gratifying results. It is not too much to say that a death under such conditions is very rare. But the concentrations of skill and experience which have brought the mortality of the early operation almost to the zero point, are by no means universally available. Every case presents its own peculiar problems of circumstance and surroundings, and no case should be sacrificed to the ambition of an upstart who is merely desirous of fumbling a handful of intestine. MORRIS questions whether rational medical treatment would not show better results in a hundred cases than a squad of occasional operators

¹ *Practice of Medicine*, 1895, Vol. II., p. 656.

could show in an equal number. A conscientious practitioner of small surgical experience should not be subjected to odium if, in the absence of skilled counsel, he trusts the issue of the case to medical means alone.

VAN HOOK,¹ in an admirable article upon the technique of the operation, lays down the infallible rule that it must always be done with the sole end in view of saving life, not to exploit some personal theory, nor to carry out some individual hobby. Operation under all circumstances is merely a choice of evils. In appendicitis it is rare that it is not the lesser of evils, but it is a thing to be undertaken with a strong sense of all that it implies under all circumstances. If an operation is performed the first day, it should be only because a greater danger to life may develop from disease on the second day.

Certain cases of appendicitis are in the nature of things inoperable. Such cases include those in which no operation of a major character should be undertaken, either by reason of great age or on account of advanced organic disease of vital organs; those whose unavoidable surroundings are such that the after treatment must be neglected; those whose end would certainly be hastened by any operative manipulation, and in those cases where a desperate hope, ending in failure, would bring thoughtless odium upon surgery. Surgeons should be mindful of the fact that a few hours delay, followed by a thorough post-mortem examination, will often serve a powerful educational end and will sometimes fix beyond all question a wholesome lesson in the minds of those who would only rejoice in the failure of surgery in a desperate extremity. A quart of pus flowing from the abdomen of a dead person arouses sympathy for the deceased rather than censure for the one who evacuates it, and will frequently

¹ *Journal of the American Medical Association*, February 20, 1897.

serve a useful purpose where a hopeless operation would only succeed in stirring up a crop of ugly personal resentments.

When, on the other hand, is IMMEDIATE OPERATION IMPERATIVE? Whenever the following conditions are present:

SHOCK.

CHILL.

COLLAPSE of an abscess wall, regardless of symptoms, which may not appear for some hours.

INTOLERABLE pain lasting more than two hours, after the intestinal tract has been evacuated, and in defiance of other rational measures for its relief.

SUDDEN subsidence, or violent reappearance, or pronounced shifting of pain.

SHARPLY drawn facial lines, regardless of pulse, temperature and degree of active pain, if increased bloating, tenderness upon pressure, and vomiting are present.

INCESSANT and uncontrollable vomiting.

The following indications denote that the necessity for operation is IMPENDING:

Pulse above 110 continuously for three hours.

A steadily rising pulse for three hours.

Excessive vomiting.

Increased bloating.

Steady increase in pain.

Presence of "tumor."

Persistence of all symptoms, or aggravation of special symptoms, in defiance of proper treatment.

Operation may, upon proper consideration, be recommended AT TIMES under the following conditions:

In a patient who has had one severe attack, who dreads a second outbreak, and whose business requires his presence at a point remote from skillful medical attendance.

In cases of returning pain after complete closure of an abscess cavity by granulation.

In a case of intractable appendicular pain of moderate character, accompanied by symptoms of general abdominal disturbance, regardless of a history of acute inflammation.

There are numerous instances in which it is highly desirable for many reasons to postpone operative interference, and it becomes of the first importance to know what indications may be depended upon. It is well under such circumstances to forget the appendix as nearly as possible and to rely upon the general indications—the easier facial expression, the diminished bloating, the milder pain, the returning appetite—the reassuring expressions of disease in retreat that defy all attempts at portrayal. To say, in the absence of something more specific, that the clinical instinct is a guide above all others may not fulfill some eager student's desire for precise knowledge, but the world of affairs recognizes this quality every day when it calls to its aid in critical emergencies those practitioners of known bed-side skill rather than those who possess the largest number of books. A gentle decline of the patient's sickness, without a wrench or a plunge at any turn, conveys to the old clinician information as important as that which a mariner gathers under full sail, without being able to communicate it to a bystander on his first voyage. Note the exaggerated comfort of a woman during the first moments of postpartum bleeding; observe the flash which a dying appendix gives off when it succumbs to gangrene. "Sudden changes" cannot be given in hours, minutes and seconds, yet they do not escape the eye of one who is familiar with the clinical features of disease.

CHAPTER VII.

Medical Treatment.

DURING the first hours of an attack of appendicitis the indications for treatment are both active and preparatory.

In all cases, even in those seen so early that the diagnosis is not positively established, the patient should at once be confined to bed. This is a positive indication in every case, and its practical bearing upon the fortunes of the patient is so obvious that little trouble is met with in enforcing it.

Perhaps the first symptomatic indication requiring attention is the pain. It is here that a fatal blunder is often committed. The distress of the patient is occasionally very severe, and the physician, in an unguarded moment, is likely to comply with a sharp demand for a dose of morphine. Such practice is to be condemned without compromise. Opiates not only fail to act curatively but so becloud both physician and patient that great and entirely unnecessary dangers are thrown about the case. The dangers of mild cases are magnified unreasonably and the landmarks of the treacherous cases are frequently destroyed when their manifestations would be of the highest practical value to the patient. A surgeon was once purposely deceived concerning the use of frequent and increasing doses of morphine in a case of appendicitis. The result was that he mistook a slow pulse and a clouded mind for the manifestations of shock, gave a very disquieting prognosis, ordered an immediate operation, which was not at the time urgent, and suffered thereby considerable

humiliation until the patient himself openly confessed that he had been solely responsible for the reckless deception practiced. It is hardly too much to say, on general principles, that the scientific attainments of a medical practitioner may almost be judged by the smallness of the quantity of opiates that he uses in his practice. In appendicitis the use of these drugs is fraught with such positive and dreadful dangers that it is a difficult matter to find an excuse for their administration under any circumstances. The case must be rare, indeed, in which a patient, if frankly informed of the peculiar dangers involved, will deliberately choose the dangerous path. It may be stated, too, that the soothing powers of opium in this affection are considerably exaggerated, and the physician who uses it is tossing overboard landmarks of priceless value for a wholly uncertain palliative.

A poultice of hot flaxseed placed over the right iliac region is extremely soothing and perfectly safe. It can be spread over the entire abdomen if desirable, and often affords prompt and grateful relief. In severe cases, hot cloths, wrung out of water at a temperature of 110° and frequently changed, are very valuable in relieving violent pain. Some practitioners blister the surface with croton oil, cantharides or turpentine; others freely paint the skin with tincture of iodine. Leeches are so highly thought of by some that their use may be mentioned. At times the application of cold, either in the form of ice bags or cloths wrung out of ice water, is preferred by the patient. It may be questioned whether, in view of possible operative demands later on, the blistering of the skin is altogether a safe procedure. Hot poultices or cold applications, in conjunction with constitutional remedies, are generally all that are required for the relief of pain, provided the bowels are thoroughly emptied.

Constitutional remedies should be carefully administered

with a view of bringing the general inflammatory process under control as rapidly as possible. It is the patient's general constitutional condition that should be the basis of the treatment rather than the mere local manifestations which are almost identical in many instances. The following remedies are most frequently indicated.

Aconite. Great mental distress; restlessness and tossing about; predicts death; skin hot and dry; urine hot, dark and passed with difficulty; especially adapted to plethoric persons.

Arnica. Excessive soreness of entire abdomen; cringes under the slightest pressure; cannot bear the weight of the bed-clothes over the abdomen; fears some one will jar the bed.

Arsenicum. Teasing thirst for small quantities of cold water; extreme restlessness; bodily exhaustion; generally worse after midnight; pains relieved by heat.

Belladonna. Full, bounding pulse; throbbing carotids; face flushed; abdomen decidedly tympanitic; pains come and go rapidly; nausea persistent.

Bryonia. Sharp, darting pains; thirst for large quantities of water; the slightest pressure over affected part is unendurable; history of constipation with hard, dry, dark passages.

Camphor. Very useful in shock; surface cold, with ashy color of skin; restlessness.

Colocynth. Predominance of colicky pains; tremendous griping, cutting pains about the navel; patient lies bent forward with something pressed against the abdomen; pains more neuralgic than inflammatory; little or no fever.

Gelsemium. Chilliness in back and limbs; trembles from weakness; drowsiness.

Hepar Sulphur. After operation, excessive suppuration;

pimples on other parts of the body; slight wounds do not heal kindly.

Kreosote. Frequent vomiting of greenish, bitter liquids; burning pains in the mouth, esophagus and stomach.

Lachesis. In septic cases; great prostration and weakness; the patient lingers from day to day in a low condition without substantial reaction; the wound looks bluish and sluggish; smaller discharge than usual, inclined to be sanious rather than purulent; patient awakens from sleep more prostrated than before.

Lycopodium. Great bloating, and rumbling of gas before or after operation; of great value in gas pains following operation.

Mercurius. Constant desire for stool; straining after a passage; gripping pains in abdomen; considerable mucus in discharges; vesical tenesmus.

Nux Vomica. Patient ill-tempered and surly; in dissipated, sedentary, hemorrhoidal subjects; frequent desire for stool but passes nothing.

Opium. Intestinal inaction after operation that is not relieved by enemata; long history of constipation.

Silicea. Sluggish wound after operation; in patients of feeble circulation; pus has a penetrating odor.

Staphisagria. According to FARRINGTON, "This is the remedy for smooth, clean cuts, such as are made by the surgeon's knife, and hence it is called for in symptoms which are traceable to surgical operations. Even if the symptoms which follow are not apparently connected with the symptomatology of staphisagria, you may expect, when they arise from this cause, to obtain relief by its administration."

Veratrum Album. Sudden shock with extreme prostration; surface cold; profuse cold sweat on forehead.

The thorough evacuation of the alimentary canal is demanded at the outset in all cases of appendicitis. It is necessary to bear in mind the surgical character of the disease, and to know that the most violent complications appear without warning. An intestinal tract loaded with effete matter is, in view of certain contingencies, a menace that must in no case be overlooked. An empty canal also goes far to reduce the pain. The condition is purely mechanical and must be dealt with along mechanical lines. In cases where the stomach is quiet, it is well to give two tablespoonfuls of a mixture containing one part of glycerine and two parts of sweet oil every half hour until decided results are obtained. The soothing influence of sweet oil has been noted by scores of competent observers, and the addition of the glycerine renders it more palatable. Sweet oil may be given at intervals throughout the attack. Some practitioners give saline purgatives by the mouth, and of these the officinal Citrate of Magnesia solution is perhaps the most palatable. Epsom salts, in doses of half an ounce dissolved in water, are generally well retained and give excellent results. Should nausea follow their use, a freshly cut lemon promptly applied to the mouth will ordinarily control it.

Purgative medicines must be supplemented in all cases by abundant enemata. The colon, even in persons of robust health and of active habits, often contains a surprising quantity of hardened fecal matter, and repeated enemata are required to dislodge it. A preliminary enema of a quart of hot water, to which is added four ounces of the glycerine and sweet oil mixture, may be given, after which hot salt water is all that is ordinarily required. Efforts at cleansing the alimentary canal must not be abandoned hastily. Often the third and fourth enemata are successful after the failure of former ones. Should

the colon appear to be sluggish and not respond readily, a fluid drachm of spirits of turpentine may be added to a pint of hot water and thrown into the colon.

All enemata must be thoroughly and skillfully given. The patient should lie on his face, the fluid should enter the colon very slowly, and be retained for a quarter of an hour before an effort is made to expel it.

In cases of vomiting it may be wise to make no effort to give purgatives by the stomach. At such times Epsom salts should be added to the enemata in quantities of two ounces.

It is not a matter of vital concern what particular drug is employed for cleansing the alimentary tract; the principle involved and the issues at stake are the things to be borne in mind. For definite mechanical reasons the intestines must be freed from waste matter. This is best accomplished by the combined use of purgatives and enemata, but may be carried out by enemata alone when the stomach is irritable. This preliminary treatment must not in any case be neglected. The patient must be prepared for a critical emergency which may be but a few hours ahead, as indeed, it so often is. Such preparatory treatment not only reduces present distress but puts the patient into the best possible condition to recover with or without the intervention of operative treatment.

When the alimentary tract is emptied, the question of diet must be considered. Much depends upon the condition of the stomach. The whims of the patient are not to be trusted for a moment, and all irresponsible feeding must come to an end at once. Buttermilk may be given freely. Sweet milk is not so desirable. Malted milk, hot or cold, seasoned to taste, is very valuable. Lemonade, cocoa, tea and coffee may be given if desired. Meat broths, pea soup and fresh fruit juices are unobjec-

tionable. Watermelon is indicated at all times if it can be retained. The question of diet is considered more fully in another section of this book.

In many cases decided improvement is manifested about the third day. At such times a keen appetite is a troublesome factor which must be firmly repressed by the physician. There are many treacherous signs of improvement and many a patient has died from reckless feeding where common prudence would have dictated the greatest caution. So long as pronounced tenderness can be detected in the right iliac region the patient must be restricted absolutely to a nourishing diet of liquids. A nourishing enema of sweet milk and the white of egg is of great service in cases where the irritation of the stomach renders it inadvisable to supply sufficient quantities of nourishment through the natural channels. A week or ten days may elapse before it is wise to permit the ingestion of solid foods, but there must be no relaxation of that tireless vigilance which is demanded in every case of appendicitis.

The matter of diet has been emphasized for the best of reasons. The instructions here given may be violated without disaster many times, but the safe course is to adhere to them in spite of the fortunate exceptions that occur in the experience of those whose actual knowledge of this disease can be rightly estimated by the clumsy fashion in which they deal with it. Let not some over-confident practitioner who has treated four or five cases at most put his ignorance against the accumulated experience of a large number of studious, skillful men whose conclusions are based upon thousands of classified cases. The number of recoveries in spite of wretched mismanagement is really very large, but this fact fortifies the conclusion that many more lives would be saved by adhering to the rules of safe practice. Cer-

tainly the whimsical freaks of chance are not to be accepted as logical guides in the place of scientific facts.

Vomiting is generally present at some stage of the attack, and is often a very distressing symptom. As it is usually reflex in character, remedies ordinarily useful are here seldom beneficial. A mustard plaster over the epigastric region sometimes palliates it, and a similar application to the base of the spine is of service in exceptional instances.

If the bowels have been well emptied, and the rules of rational dieting rigidly adhered to, the intestines may be left to themselves for four or five days without further treatment.

Accumulations of gas in the colon can be relieved promptly by the passing of a perforated drainage tube two or three inches into the rectum.

The functional activity of the urinary bladder is occasionally disturbed to such a degree that the use of a catheter (properly sterilized) is demanded.

A chill demands prompt attention. The patient should always have a hot water bag near his feet, and, in case of chill, others should be applied around the trunk and limbs. An enema of strong hot coffee is of great service. If the signs of shock are present, due to a perforation or to the sudden rupture of an abscess, careful stimulation may be demanded. In an alcoholic subject the heart may show especial signs of weakness. Strychnia nitrate in doses of 1-40th of a grain administered hypodermatically enjoys a high repute in such emergencies. Food and drink should not be given by the stomach. All stimulants should be used with due caution.

Should prompt reaction follow the chill, and the objective symptoms begin to localize, it may be suspected that the peritoneum has surrounded the infection by a protective exudate;

but the symptoms at such a time are so deceptive that all opinions regarding the real condition of affairs inside the abdomen amount to nothing more than the merest speculation.

Delirium is commonly associated with sepsis, and is then a symptom of the most serious import. Some persons, however, become flighty with a very slight rise in temperature, and this peculiarity must be recalled in cases where the condition is present.

The persistence of vomiting, an increase of bloating, delirium, and a steadily rising pulse are evidences of diffuse peritonitis, and the case will probably require no special treatment during the few remaining hours of life. Such patients are usually so benumbed by sepsis that even the morphine expert is likely to stay his hand while the narrowing circle of life slowly blends with the expanding circle of death.

In the *chronic or sub-acute forms* of appendicular trouble, medical and dietetic treatment are of decided value, not only in mitigating the distress of the patient but in certain cases of demonstrating the futility of such means in bringing about a cure. A chronic case that does not yield with reasonable promptness to treatment of this kind may justly be regarded with considerable suspicion. The diet should be regulated, violent muscular exercise prohibited, and such medicine prescribed as the constitutional condition of the patient may require. It may at times be most desirable to bring about a better state of health before resorting to operative measures, even when the latter are clearly conceded to be necessary. A regular diet of nourishing food, a daily movement of the bowels, and a proper amount of rational exercise are the main indications to be followed.

A chronic liquor drinker who has survived a primary attack of acute appendicitis, and who is under medical care with the

hope of forestalling another outbreak, should be informed that, aside from the influence of alcohol upon the affected structure, his earthly chances depend in a decided degree upon his total freedom from all artificial stimulation. An alcoholic subject offers poor resistance to disease in general, and his prospects upon the operating table are by no means flattering.

In this connection the "smoker's heart" should not be overlooked. In fact, the person who is known to be liable at any moment to an outbreak of a condition demanding the fullest expenditure of his bodily forces, in a hand-to-hand struggle with disease, should be careful of how he pours out the precious energies of life in wasteful and debilitating practices.

Notwithstanding a whimsical prejudice to the contrary, a liberal diet of fruits is desirable in cases where it is necessary to overcome sluggishness of the bowels, thus diminishing the chances of trouble in any quarter of the abdominal cavity. The influence of fruit seeds in the production of appendicitis enjoys such an exalted position in imaginative literature, and appeals with such convincing force to the popular fancy, that the pitiful conclusions of science are powerless to dislodge it. In this connection the grape seed has fallen into undying fame, whereas the smaller and far more dangerous seeds are swallowed by millions without so much as a line to their credit. That fruit seeds never cause appendicitis is not claimed; that they ever cause it remains to be proven.

The post-operative treatment is considered in another chapter. It is sufficient in this place to say that the use of medicines in the after-treatment of clean cases is seldom necessary. Such complications as follow in the train of the septic cases should be met by whatever remedies are most appropriate for the given condition.

CHAPTER VIII.

Operative Treatment.

THE indications for operative interference are elsewhere considered. The necessity for an operation having been determined, no time should be lost in carrying the decision into effect. Presuming the preliminary treatment to have been faithfully applied, the patient can be prepared for the operating table within an hour. In those cases in which the intestinal tract has not been evacuated, it is almost imperative to postpone operative measures until an energetic cathartic and repeated enemata have had time to produce the results for which they are given. A threatening emergency, such as the unexpected collapse of an abscess wall, or the appearance of shock due to perforation of the appendix, would admit of no delay. If either condition should be complicated by a loaded bowel the patient's prospects, in no case flattering, can hardly be improved by a delay for the purpose of doing what should have been done during the first hours of his illness. When the surgeon can, within reasonable limits, choose his own time for the operation, an early morning hour is generally to be preferred, for obvious reasons. Where the safety of the patient appears to demand it, an operation should be undertaken at any hour of the day or the night. In cases in which an artificial light is demanded a lamp should not be trusted in the hands of a person who is likely to faint, possibly at a moment when his services are most needed. The operative preliminaries will in any case depend upon the judgment of the individual practitioner.

The question of transporting the patient from his usual abode may or may not be a vital one. The *How*, *When*, and *Where* of every operative case must be considered with sole reference to the welfare of the patient. A well-appointed hospital is vastly more convenient for the operator, although there is no substantial surgical reason why a patient should be removed from a comfortable home, provided a general obedience to orders can be secured without it. The gorgeous paraphernalia of the antiseptic religion reflects much credit upon the development of modern taste, but the practice of surgery should not be confounded with irrelevant features of the decorative art.¹ Mr. TREVES very justly observes that "This exhibition may be scientific, but it is no part of surgery." The means for bringing about surgical cleanliness are available in almost every household.

If the operation is to be carried out in a private residence, it is useless to bare the patient's bed-room as if some wild animal were to be confined in it. The carpet, having no established place in surgery, may be suffered to remain where it belongs, upon the floor; and the wall paper and the pictures, if good enough for well people, need not be disturbed while a sick person is in the house. A suitable bed-room is, of course, desirable; it should have a reliable method of heating, proper facilities for ventilation without subjecting the patient to draughts of air, and be exposed to direct sunlight, if possible. The patient's bed should be placed in the centre of the room, so that the attendants can pass from side to side without difficulty. Some of the pedantic nonsense that is published concerning the various methods of turning a

¹See article by Mr. LAWSON TAIT on "Cleansing and Cleanliness in Abdominal Surgeons' Work," in *The Medical Record*, December 19, 1896; also "A Review of the Surgery of the Peritoneum," by FREDERICK TREVES, in *The British Medical Journal*, October 31, 1896; also "How to do Abdominal Section without Fuss, Feathers and Foolishness, with Immunity from Sepsis," by JOSEPH PRICE, M.D., of Philadelphia, in *The American Gynecological and Obstetrical Journal*, March, 1895.

house inside out before operating upon a case of appendicitis is no more entitled to respect than any other high-sounding foolishness.

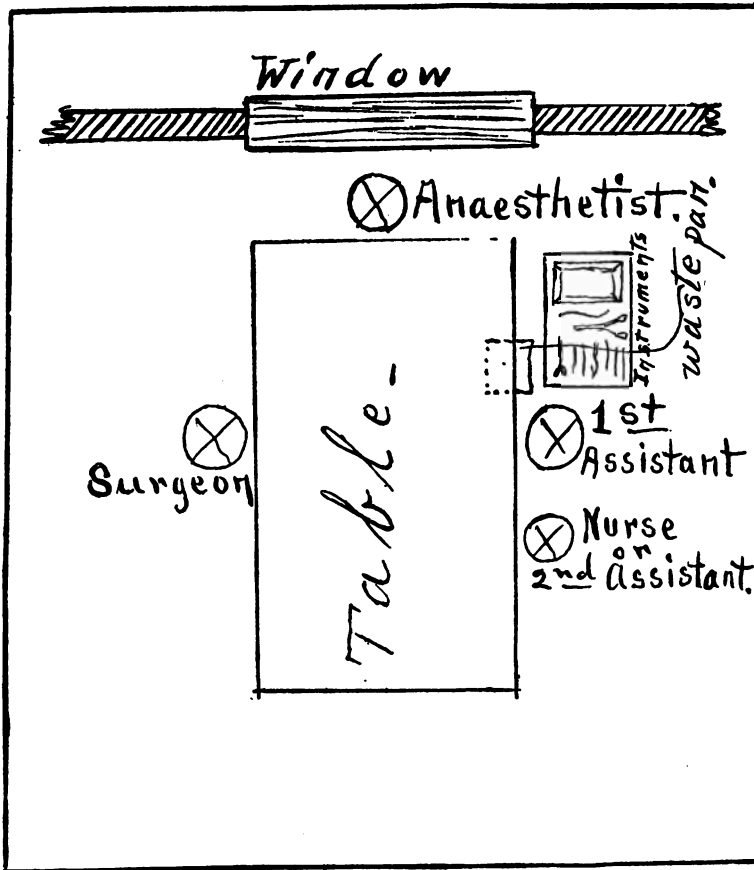


FIG. 4.

Showing the order of arrangement around the Operating Table.

The operating-room should be chosen primarily with reference to light and heat. A dining-room or a kitchen, if well lighted and sufficiently heated, are perfectly satisfactory. The

floor may be wooden or mineral, but if it be strong enough to sustain the weight of the patient and his attendants, further investigation may be postponed until the case has recovered. The walls are alive with germs, but if the plastering will pass muster the germs need not be disturbed until the wound has been closed.¹

A long, narrow kitchen table makes a very acceptable operating stand. Occasionally two shorter tables may be so adjusted as to be satisfactory. Certain modern ironing boards appear to have been designed with a surgical purpose in view, and are so convenient that nothing better is desired. Should it be necessary to put the patient into the TRENDLENBURG position, this can be done readily by placing a strong, square-backed kitchen chair in the "knee-chest position" on the table and lifting the patient upon the chair so that his legs hang down over the bottom rounds.

The operating table should be made as comfortable as circumstances will permit by padding. There is no good reason why an unconscious person should lie upon a hard surface, simply because he is oblivious to pain.

When the patient is placed upon the table his head should lie toward the window, thus permitting the light to fall directly upon the field of the operation. It may at times be necessary to place the table at an angle with the window, but the feet must always lie away from the light. It is the exception for those unaccustomed to operative work to arrange the table properly. The surgeon must give this matter attention before the patient appears in the operating room.

The anæsthetic to be given is largely a matter of personal

¹See *Manual of Surgical Asepsis*, by CARL BECK, M.D.; Philadelphia, 1895, p. 148.

experience and individual choice. It is proper to say that the anæsthetic is designed for the patient, not the patient for the anæsthetic. This question should always receive conscientious consideration, and then be decided upon a full review of the facts in hand. A word of caution is pertinent. When it is impracticable to secure the services of a skilled administrator sulphuric ether (in the absence of contra-indications) is the drug that should always be chosen. The especial risks involved in the employment of ether near a flame should be borne in mind. Chloroform, if given in the presence of a gas flame, will soon fill the apartment with the stifling fumes of chlorine, unless the ventilation be carefully regulated.

The following dressings should be procured from a responsible dealer, upon the order of the surgeon, and should always be furnished by the patient:

Five yards of sterilized gauze in a sealed jar.

Squibb's ether (or Squibb's chloroform), in sufficient quantity, in original packages.¹

One pint of alcohol.

One ounce of Squibb's collodion.

One pound of absorbent cotton.

One spool of surgeon's adhesive plaster, one inch wide.

Three cheap domestic hand brushes.

The surgeon should carefully inspect the articles specified in his order, and assure himself that all the dressings are in proper condition.

The dressings will at times vary somewhat, according to the

¹ NOTE.—It is suggested that 100 grammes of chloroform, or 250 grammes of ether, will be sufficient in skillful hands. The clean operation is frequently performed with the use of 25 grammes of chloroform, and no case is known where a 100-gramme vial has been emptied. One hundred grammes of ether is generally sufficient. A septic case requires a smaller quantity of either anæsthetic than a clean one.

necessities of the case, but those here given will be found sufficient under ordinary conditions.

The nurse should procure the following articles: A dozen or more towels, two sheets, a woolen blanket, six hot water bottles, a washboiler full of boiling water, four gallons of cold sterilized water, three or four wash basins, a stew-pan in which to boil instruments, two good sized meat platters, a soup bowl for the sponges, two saucers, a paper of safety pins, a strong bandage, wide enough to cover the dressings and long enough to encircle the patient's abdomen, a fountain syringe, and a bed pan. The towels and the sheets should be boiled in a one per cent. solution of washing soda, then ironed and deposited in a clean place. The meat dishes and the sponge bowl should also be boiled in the soda solution. Surgical cleanliness must be observed in all essential matters. The operator should assure himself that all things necessary for his work are at hand before he orders the anæsthetist to proceed.

The surface of the patient's abdomen should always be made surgically clean, and it is not a matter of great moment what precise method is adopted for securing this end. A thorough scrubbing with soap, the color of which is immaterial, should be performed first, and if the hair of the abdomen is prominent, a razor should be used to clear the field of operation. The shaving should not be done in such a manner as to scatter solitary hairs promiscuously over the abdomen. The hairs will generally adhere to the razor when cut and the instrument should be carefully wiped with gauze as often as necessary. Following the scrubbing it is customary with some to apply turpentine spirits with a brush. A solution of corrosive sublimate (conveniently prepared by dropping four of the BERNAYS tablets into a quart of boiled water) is often employed. Alcohol is finally applied in

substantial quantities, when the abdomen should be covered with a sterilized towel and await the orders of the operator. All of these procedures should be executed with a full regard for their importance.



FIG. 5.—Scalpel.

The instruments required depend somewhat upon the pathological condition existing at the time of the operation. Under all ordinary conditions, the following are sufficient: A razor,

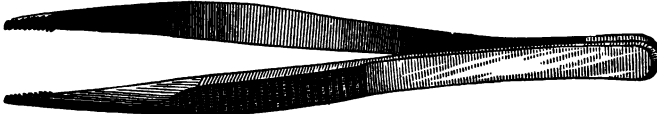


FIG. 6.—Dissecting Forceps.

one sharp scalpel, two pairs of dissecting forceps, two retractors, a pair of straight scissors, a pair of curved scissors with blunt



FIG. 7.—Retractor.

points, a pair of angular scissors, a pair of gauze shears, a dozen pairs of artery forceps, two blunt aneurism needles, two large-sized full-curved HAGADORN needles, two full-curved flat needles,

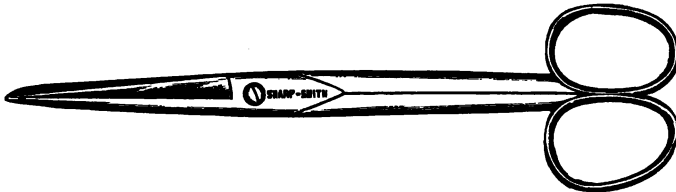


FIG. 8.—Sharp-pointed Straight Scissors.

two or three straight needles, a needle-holder, fine chromicized catgut, and three or four strands of silkwormgut.

With the exception of the razor and the catgut these are placed in a stew-pan, covered with a one per cent. solution of washing soda, and boiled for ten minutes. They are then to be distributed on a large sterilized meat platter.

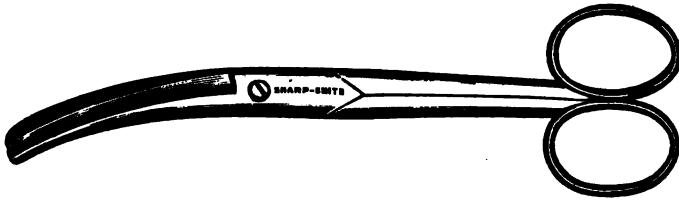


FIG. 9.—Blunt-pointed Curved Scissors.

The needles are placed in one saucer and some catgut ligatures deposited in the other. The strands of silkwormgut are conveniently grasped by a pair of artery forceps and left with the instruments.

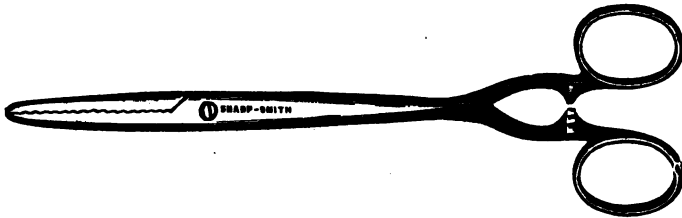


FIG. 10.—Artery Forceps.

The jar containing the gauze should be opened by a responsible person, the gauze withdrawn and cut into lengths of two or

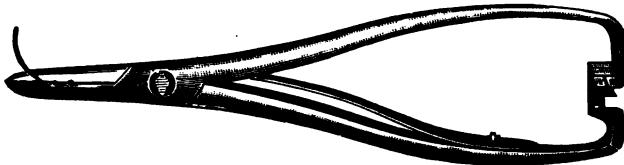


FIG. 11.—MATHIEU'S Needle-holder.

three inches. These are then made into loose pledgets and deposited in a clean bowl. The number of sponges required will

depend largely upon the pathology of the case in hand. A clean operation seldom requires more than half a dozen sponges, whereas a septic case might require twenty or more. A sufficient quantity of uncut gauze should be held in reserve to meet a possible demand for a large MIKULICZ drain.

Medicated gauze is very extensively used, although many surgeons condemn it as unnecessary if not dangerous. Sublimated gauze should not be used within the peritoneal cavity for

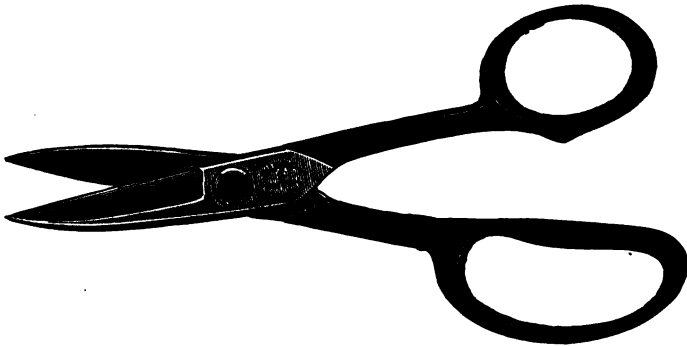


FIG. 12.—Shears for cutting gauze.

any purpose, and iodoform has produced dangerous if not fatal poisoning in some cases. Sterilized gauze gives perfectly satisfactory results, and is free from the objections that lie against the others.¹ Where only a medicated gauze can be obtained, the borated is the least objectionable.

If it be impossible in an emergency to procure a supply of surgical gauze, a sterilized cotton sheet can be utilized. Absorbent cotton should not be used for sponging.

One skillful assistant in addition to the anaesthetist is very desirable, two of them greatly facilitate the surgeon's work, but the operation can be performed where no trained assistants are at hand. The responsibility, if not the authority, of the anaesthetist

¹ See BROW'S *Surgical Asepsis*, Philadelphia, 1895, p. 66.

is so great that he may almost be called the associate operator, and in no case should his attention be divided between the two operations, his own and the surgeon's.

Surgically speaking, a patient had better be left to die of sepsis than be killed by the maladministration of an anæsthetic, however merciful the latter might appear in a given case. It must be rare in a civilized community that the services of some person of experience in the use of anæsthetics cannot be secured, but the wanton recklessness that coolly selects the stupidest of a group of assistants for the anæsthetist, on the ground that "anybody can give ether," can hardly be condemned sufficiently in moderate language. A timid anæsthetist is a great vexation to the operator, but he is preferable to the blissful ignoramus of tender experience who enjoys a reputation with himself as "something of a specialist in anæsthesia."

The chief assistant should stand opposite the operator and confine his attention to the immediate neighborhood of the wound. A second assistant, who is familiar with the handling of instruments, will greatly facilitate the operator's work. If only one assistant is obtainable (the anæsthetist not being regarded, strictly speaking, as an assistant), the surgeon will find it convenient to have the instrument-stand within his reach and attend to the instruments himself. The needles should be threaded in advance. An intelligent layman, in cases of emergency, can perform much valuable service after some instruction from the operator. With a trusted anæsthetist in charge, the surgeon can proceed quite satisfactorily with such unskilled assistance as he will generally be able to command in the neighborhood.

The hands of the operator and those of his assistants must be rendered surgically clean, it matters little by what particular method. Cheap stiff brushes (those commonly employed in

cleaning celery are very serviceable), having been sterilized by boiling, are vigorously applied with soap and water to remove gross particles of dirt. The finger nails are cut short and all accumulations removed from about them. Especial care is necessary in doing this. Following the preliminary scrubbing, the hands are washed (or rather soaked) in some sterilizing solution, such as alcohol, spirits of turpentine, or a 1:2000 solution of corrosive sublimate. A method that enjoys high favor, and one moreover that does not injure the hands, is as follows¹: A handful of chloride of lime, to which a crystal of carbonate of soda is added, is mixed with water and thoroughly rubbed over the hands and arms until a creamy paste results. After some moments of rubbing, this paste is removed by rinsing in sterilized water.

For the preliminary scrubbing of the patient's abdomen and the operator's hands the domestic sapolio is perhaps as satisfactory as any substance yet suggested for this purpose.

If the operator has recently handled septic tissues his hands must be soaked in a saturated solution of potassium permanganate, followed by a saturated solution of oxalic acid, then rinsed in corrosive sublimate solution, followed by immersion in alcohol.

Clean gowns (made of butcher's linen) should be worn by the operator and his chief assistant.

Before proceeding with the operation, the surgeon should survey with a critical eye every link in the chain that means life or death for his patient. One whose thoughts center around a glistening array of plated hardware is quite likely to forget the surgery so near at hand.

¹ See article "On the Disinfection of the Hands," by ROBERT F. WEIR, M.D., *Medical Record*, New York, April 3, 1897; also letter from LOUIS A. STIMSON, M.D., *Medical Record*, April 10, 1897.

The patient should receive the first inspection, and every question affecting his condition must be reviewed.

The temperature of the operating room should be noted. Ninety degrees is not too warm.

The precise temperature of the hot water bags must be ascertained. This may range from 110 to 125 degrees.

Next the dressings are examined, and each article is mentally checked off as it is passed by the operator's eye.

Every instrument is scrutinized with the utmost care and its condition for service determined.

A chair is placed at the head of the table for the anæsthetist and a seat made ready for the surgeon.

Nothing escapes this final inspection. The instruments, the sponges, the light, and the hands of the assistants are matters about which the operator must not be in doubt.

The patient should, as a rule, be placed upon the operating table before the anæsthetic is begun, and hot water bottles, well wrapped in cloths, placed at the feet, between the thighs and against the sides of the chest. On no account must the bottles come into actual contact with the patient. The surgeon must give this matter his personal attention. It is a crime to burn a patient through carelessness.

The field of operation is given a final scrubbing with alcohol, and clean towels, secured by safety pins, are so placed as to surround the proposed wound.

No matter what condition may be present in the abdomen, the scrubbing should in no case be omitted. It is the duty of the surgeon to remove filth, not to add to the accumulation.

All things being in readiness, the operation is in order.

The usual operation for the removal of the vermiform

appendix will be described first, after which the ordinary complications will be dealt with.

An imaginary line should be drawn from the navel to the anterior iliac spine. The proposed incision should cross this line at nearly a right angle, somewhat closer to the iliac spine than to



FIG. 13.

Showing direction and location of the ordinary incision.

the navel. The center of the incision will ordinarily be found to fall very near the imaginary line.

With a sharp scalpel the skin is divided in a line following the trend of the external oblique muscle about three quarters of

an inch nearer the iliac spine than the navel. Some bleeding points appear. These little vessels require no ligature, momentary compression being generally sufficient to close them. Capillary oozing is controlled by sponging.

Retractors are employed as the operator may direct.

The underlying layer may, or may not be, a fatty one. It is divided with a firm, clean cut down to the next layer. The fat

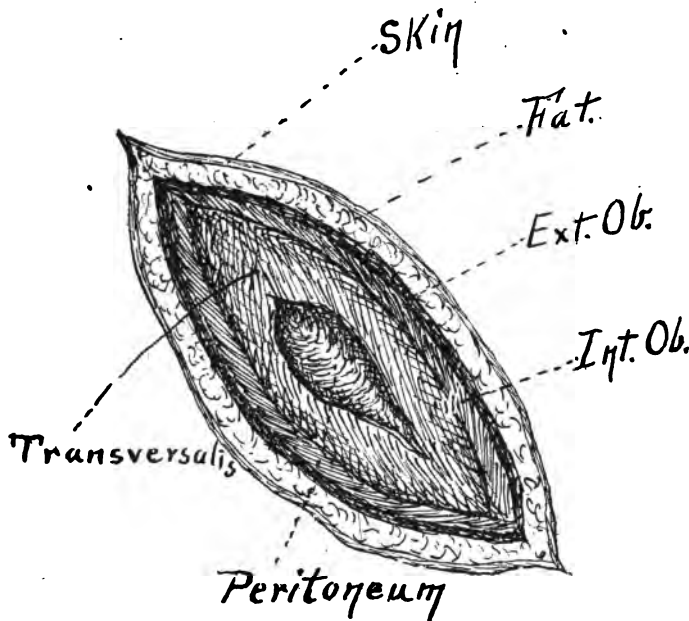


FIG. 14.

Showing the different layers of the Abdominal Wall.

bleeds freely at times and its vessels may require torsion. Care should be exercised in not tearing or bruising the fatty layer. Suppuration is prone to start from such causes.

Below the fat the smooth aponeurosis of the external oblique is exposed. It is very thin and can be separated in the line of its fibres without cutting.

A fleshy muscle, the internal oblique, sometimes an inch thick, but usually much less than this, is now in view. Its fibres cross those of the muscle above it at a right angle, hence it is cut squarely across. It frequently contracts vigorously when irritated by the edge of the knife.

The skin, the fat, the external oblique, and the internal oblique are all divided smoothly throughout the length of the skin incision down to the transversalis. The length of this incision is a matter for the exercise of individual discretion. In

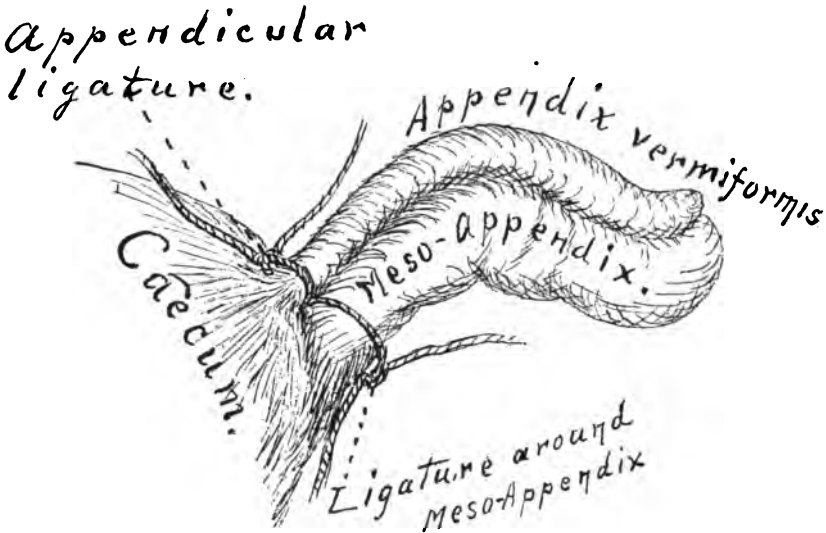


FIG. 15.

Separate ligatures passed around the appendix and the meso-appendix close to the caecum.

a thin subject it need not be longer than an inch and a half to two inches; in a fleshy person it should at times be more.

The transversalis fascia having been clearly identified, it is divided for the space of one-fifth of an inch for a definite purpose. Into this small cut a bulging of tissue from below will

be observed in most cases. It is the peritoneum. A coil of gut cannot bulge into so tiny a seam. The peritoneum may not appear as is indicated; the gut may be glued to the abdominal wall and it is necessary to advance with caution. The transversalis is again divided with another gentle incision, some distance from the first, when the characteristic bulging may appear. If the second attempt is futile the transversalis may be divided throughout and the peritoneum identified by other means. This membrane can often be raised sufficiently to permit the transmission of light, a thing that cannot be said of the intestine. In cases of serious doubt the suspected tissue should be gently scratched with the point of the scalpel; the parietal peritoneum under such treatment will quickly give off a drop of clear serum whereas the gut will slowly become covered with pinkish-colored serum. The knife at this point is the safe instrument, and the scissors should not be seized under the impression that they will supply skill and judgment to the operator. To insure against a possible accident, the presenting tissue should be grasped firmly between two artery forceps, placed very closely together, and an incision made between them. If a gut should be wounded it is within the control of the operator. The first incision through the peritoneum should always be a very small one; the opening can be readily enlarged when the cavity is demonstrated.

The proper instruments for the opening of the abdominal cavity are a sharp scalpel, a pair of dissecting forceps, and properly applied retractors. There is no excuse for bruising and tearing the tissues with the fingers. Each layer should be evenly and cleanly divided in its turn, the assistant in the meantime keeping the field dry by sponging.

There is no occasion here for brilliant operating. A substantial result is much more desirable. A young operator with more

presumption than skill who desires to do some hysterical slashing for the edification of a gaping throng of bystanders had better confine himself to thigh amputations and the removal of fatty tumors from the back.

The peritoneum and the transversalis aponeurosis should be secured by loops of catgut in order that these structures may be promptly brought to light when the time comes to close the wound.

The peritoneum having been opened for the full length of the external wound, the appendix should be sought in a systematic manner. In some instances it can be secured at once, but this is not often the case. The colon is generally easy to find and can instantly be identified by the ribbon-like band of longitudinal muscular fibres. This band leads straight to the appendix. In case of doubt, the band, if put upon the stretch, feels like a cord to the exploring finger; if it lead toward the navel it is the transverse colon; if toward the pelvis it is the cæcum. By no means can the appendix be elsewhere than at the lower end of this cord. It is brought outside the abdomen and a hot strip of gauze carefully covers the tip of the exposed cæcum. No chemical solutions should be used after the incision is made, and only physiological saline solution (a teaspoonful of common salt to the quart of sterilized water) should be used in heating the sponges that are applied to the cæcum.

The appendix has a variable mesentery. It is sometimes absent, and is often extensive. This should be dealt with first. A ligature of fine chromicized catgut is threaded upon a dull aneurism needle and passed between the appendix and its mesentery close to the cæcum. More than one ligature is frequently demanded. These ligatures must be carefully tied, after which the mesentery is cut away almost to the base of the appendix.

A ligature of the same material is next placed around the appendix at its base, and secured by repeated knots. This field is a poor one for spectacular operating. A gentle touch and much patience are required. All ligatures are slowly and firmly applied; each is given time to take a secure hold upon the tissues before a knot is tied.

The ends of the appendicular ligature are left long for a time.

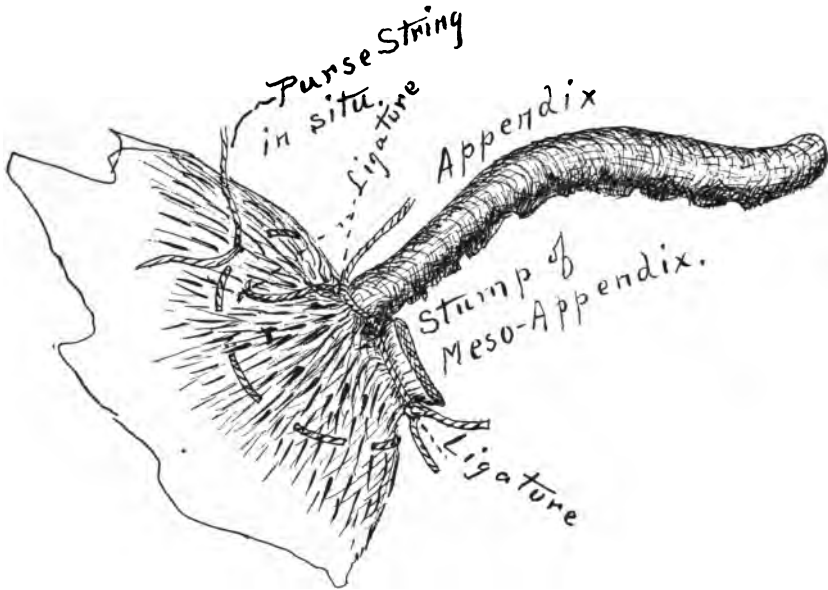


FIG. 16.

Cæcum scarified around base of appendix; the appendicular mesentery cut away; the purse string ready for tying as soon as the appendix is amputated; all ligatures to be cut short.

A delicate and vitally important procedure is next in order—a step that should not be neglected in any case where it is practicable, and without which a small drainage wick is necessary. Probably no tissue in the body unites with the certainty and the

rapidity of the aseptic peritoneum. When scarified peritoneal surfaces are brought together by a suture they become glued within a few hours so that leakage is impossible. To tie the appendix like an artery, then amputate it and leave its mucous stump uncovered by peritoneum is a performance that cannot be justified, where the proper course is possible, in a clean case. A straight needle is grasped between the thumb and the index finger and a circle of tissue somewhat larger than a silver quarter

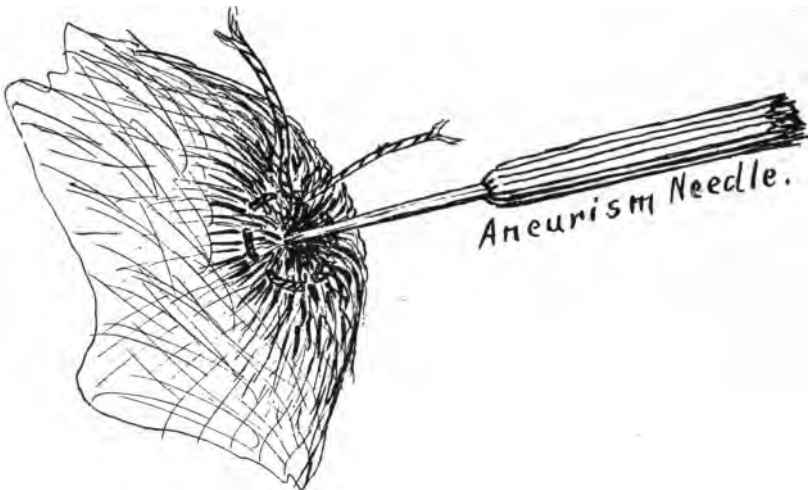


FIG. 17.

Tightening the purse-string as the stump of the appendix is driven home by the blunt aneurism needle.

is gently scarified upon the cæcum around the base of the appendix. Pinkish serum slowly appears, but is not removed. The needle is then armed with fine catgut and a purse-string suture is placed at the outer limits of the sacrificed circle by passing the needle six or eight times through the peritoneal coat of the cæcum. Folds in the gut are misleading at times, and the

last bites of the needle are apt to run too close to the base of the appendix unless caution is exercised.

The ends of the purse-string are next drawn upon, the appendix is relaxed a trifle, and calculation is made as to whether the purse-string, when tied, will completely bury the stump when the appendix is cut away. Should there be any doubt upon this point, another purse-string should be inserted at a somewhat greater distance from the base of the appendix.

The matter being set at rest, the appendix is now amputated with a pair of strong, blunt-pointed scissors, about one-eighth of

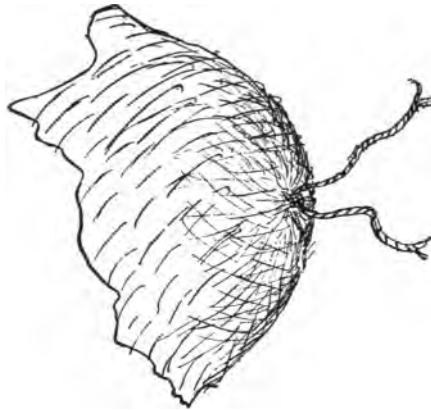


FIG. 18.

The stump buried ; the ends of the purse-string to be cut short.

an inch from the ligature at its base. A little pad of gauze is in readiness to receive any drop of infectious matter that may escape. Some operators advise the use of two ligatures; the amputation to be made between them. The double ligature is seldom necessary. An artery clamp would serve the same purpose as the second ligature. Following the amputation it is customary to apply some caustic to the mucous membrane of the

stump. A fraction of a drop of strong carbolic acid applied with a needle is perfectly satisfactory. The peritoneum must not at this point, nor at any other, be damaged by contact with a strong chemical. The ligature around the base of the appendix is now cut close to the knot.

The ends of the purse-string are next drawn, the stump being pushed beneath the coil as the knot is tied. When the ends of the purse-string are cut short the cæcum should be returned to the abdomen. It is not only useless but nonsensical to sponge out the abdominal cavity following such an operation as the one here described. The habit of using a sponge at random, in the absence of something more definite to do, is no more harmless than many another aimless procedure.

The catgut loops commanding the peritoneum are now drawn upon, and this membrane is united throughout by a running suture of fine catgut. In many cases the peritoneum and the transversalis are so blended that these structures must be closed as one layer. It must be borne in mind that the transversalis is the strongest tissue in the abdominal wound and it must be closed accurately and securely from end to end of the incision. The familiar "button-hole" stitch is very satisfactory for this work.

When the peritoneum is closed, a large, full-curved HAGADORN needle, armed with silkwormgut, should be carried through all the layers (skin, fat and muscles), down to, but not through, the peritoneum, and left untied until the skin is sutured. In an inch-and-a-half incision two of these retaining stitches are sufficient. Should the peritoneum and the transversalis be closed together as

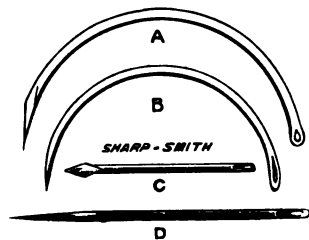


FIG. 19.

Curved HAGADORN, lance-pointed and round-pointed straight Needles.

a single layer, the retaining stitches do not, of course, penetrate the latter, as they do in cases where the two layers are united separately.

Especial care is necessary in securing the internal oblique.

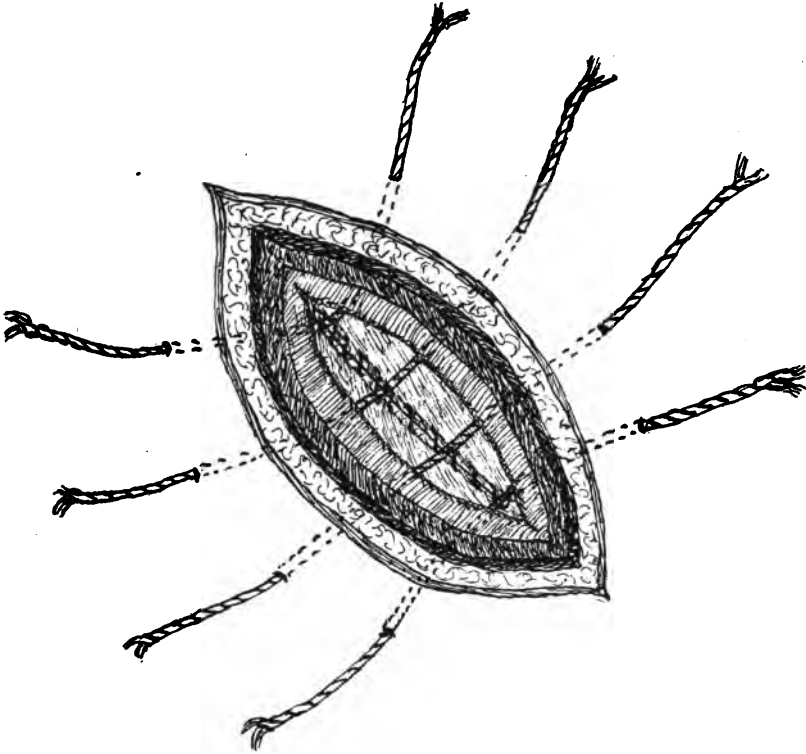


FIG. 20.

The peritoneum closed by a continuous suture of catgut; the retaining stitches of silkwormgut (including all layers but the peritoneal) in place, but not tied.

It tears easily, and, being cut at a right angle with its trend, it is naturally more difficult to unite than the other layers are. It can not, as a rule, be united satisfactorily by a running suture, but the retaining stitches should include it as deeply as practicable.

The external oblique requires a few stitches of catgut.

Next the skin is hooked at the ends of the incision by the aneurism needles and put upon the stretch. It is rapidly closed by a straight needle armed with catgut.



FIG. 21.—Blunt Aneurism Needle.

Finally the supporting stitches of silkwormgut are tied, not too tightly, and the incision is smeared with Squibb's collodion. Three or four layers of gauze, a light pad of absorbent cotton,

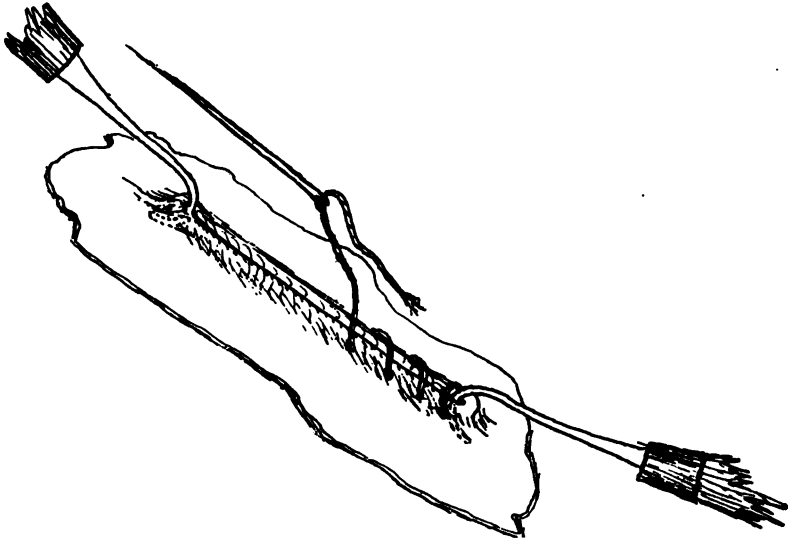


FIG. 22.

Method of closing the skin incision.

some strips of adhesive plaster and a wide bandage secured by safety pins, complete the operation.

The anæsthetic may generally be suspended when the peritoneum is closed.

The patient is now transferred to bed, and there is no occasion for arousing him until the effects of the anæsthetic are gone. The head should be kept low, no pillow, as a rule, being desirable during the first twenty-four hours following the operation.

If nausea follow, the lips should be moistened with vinegar, and cold cloths placed about the neck.

The following dietetic suggestions may be consulted:

DAY BEFORE OPERATION. Keep patient in bed; cold water, cold lemonade, coffee, tea, buttermilk, pea soup, boiled rice with cream, malted milk salted to taste, proteinol.

DAY OF OPERATION. Neither food nor drink for six hours before operation. *After Operation.*—If nauseated, moisten lips with vinegar; give no liquids by mouth till stomach becomes quiet; *hot* water with a few drops of lemon juice added; hot tea; hot malted milk well salted. Intolerable thirst is palliated by high enema of normal saline solution (teaspoonful of table salt to quart of sterilized water at a temperature from 100 to 106°).

SECOND DAY. Fresh ripe watermelon juice; cold water; tea, hot or iced; hot malted milk; buttermilk, koumiss or matzoon; proteinol.

THIRD DAY. Watermelon juice, buttermilk or matzoon; proteinol; cold water; tea, coffee; malted milk; orange juice; Irish moss; peptonized milk.

FOURTH DAY. Meat broths; clam broth; cream toast; watermelon; orange juice; fresh peaches without cream; ice cream or lemon ice; proteinol; the ordinary liquids.

FIFTH DAY. Ripe watermelon; ripe peaches without cream; boiled rice with cream; chicken, beef or mutton broth; pea soup; potato soup; cream toast; proteinol; water, tea, coffee, buttermilk.

SIXTH DAY. Broiled breakfast bacon; soft-boiled eggs (three

minutes in boiling water); toast, dry or with cream; sliced peaches; sliced tomatoes; watermelon; fresh berry juices; fresh (not bottled) grape juice; boiled rice or barley with sugar and cream; ordinary drinks.

SEVENTH DAY. Rare sirloin; rare roast beef; meat broths; pea or potato soup; eggs, poached or soft boiled; corn cakes buttered; toast to taste; sliced tomatoes; peaches to taste; baked potato; baked apple; peas; celery.

The patient ordinarily requires no nourishment during the first twenty-four hours following the operation. Neither food nor drink should be thrust upon an irritable stomach. When the effects of the anæsthetic have fully passed away, some appropriate articles should be selected from those mentioned and given in moderate quantities. After the fourth day a vigorous appetite should be gratified by a liberal allowance of substantial food.

A few hours after the operation the pulse should be normal, or nearly so, and should remain at that point with trifling variations unless disturbed by complications. A spurt of fifteen to twenty beats after the third day can probably be traced to some slight disturbance in the external wound, unless the bowels have not received proper attention.

The temperature is of slight significance. If taken early in the morning, before the patient has eaten, it is frequently found to be subnormal.

An enema of warm salt water should be given on the third day, and on every day thereafter while the patient remains in bed. If this practice is neglected, a disturbance of the pulse and temperature, accompanied by general discomfort, may be looked for.

The pain after a clean operation is seldom of much consequence if the intestines are kept free from gas. A rectal tube

affords prompt relief in many cases, but an enema is indicated where the tube fails to produce the desired result.

The wound requires no attention until the fifth day, or even later. The supporting stitches may be removed when the wound is first examined, or permitted to remain a few days longer, in the absence of local redness or irritation. If undue redness is present around the edges of the wound, it may be suspected that primary union will not be secured. The pulse should be carefully watched, and if it rises to a hundred, accompanied by some pain in the wound, a slight opening should be made in the skin and a small wick of gauze inserted for drainage. Primary union is almost the invariable rule in clean cases, but it is not always secured even with the most scrupulous care, and pus in the superficial wound should be immediately removed. Irrigation is not desirable.

The mere presence of pus is pretty sure to alarm the patient, who generally concludes that the trouble is from the peritoneal cavity. His fears should be promptly set at rest by informing him that the peritoneum is in no way involved in the process.

Promiscuous visiting should not be allowed. It is a great nuisance and does much positive mischief.

As a rule, the patient is able to be dressed and around the house about the tenth day, and can usually resume his vocation in two weeks. No pad is necessary over the scar unless his occupation demand unusual physical exertion.

ORDINARY COMPLICATIONS OF THE CLEAN OPERATION.

The abdominal wall may be abnormally thick in one or more of its layers, thus necessitating a longer incision than usual. A pair of angular scissors are very convenient for enlarging the primary opening.

An arterial twig occasionally requires torsion when the incision is carried upward beyond the usual limits. In extending the opening downward the location of the deep epigastric artery must be borne in mind. The pulsation of the vessel can be felt, and it should not be wounded.

The muscular and fascial layers are not always the same in different subjects, and it is at times impossible to identify all of them clearly.

The peritoneum is at one time as thin as an ordinary sheet of newspaper, and at another time as thick as a layer of heavy woolen cloth.

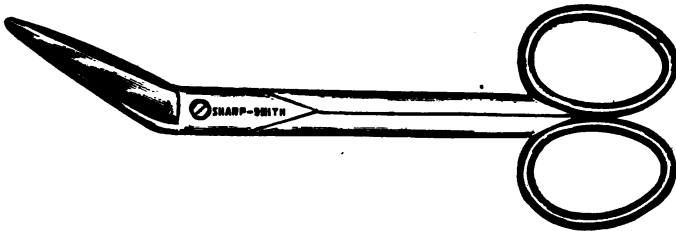


FIG. 23.—Angular Scissors.

After opening the peritoneum the task of locating the appendix may prove to be very difficult. The cæcum is not always so much in evidence as some suppose. Adhesions generally account for the difficulty in bringing the appendix into the wound. On no account must the operator begin a course of aimless poking and pawing, hoping thereby to locate the appendix by accident. An acute and trained finger is necessary in identifying this pouch surrounded by viscera and lying deep in the abdomen. If a mass of plastic exudate—"peritoneal cement"—is found, it may be suspected that some part of the appendix is buried in it. Extreme care is now essential, or a "clean" operation may suddenly change its character upon the rupture of the wall of a minute abscess. An unerring practical test at such

times is found in a good sense of smell. The index finger must be withdrawn frequently and subjected to the nasal test; and it may be here remarked that the surgeon who can not identify pus found under such circumstances without an elaborate examination has no business undertaking a serious operation upon the living human subject. The appendix is carefully released from the bed of lymph by judicious use of the finger nail, and, if clean, dealt with precisely as if no such tedious complication had been met with. Some hemorrhage will follow the separation of adhesions, and a strip of gauze should be cautiously introduced, and the procedure repeated, until the oozing, usually slight, has been controlled. The abdomen is then closed as before.

In certain cases circumscribed plastic adhesions may try the patience and the skill of the most expert operator to the utmost. Nor is the identification of the appendix under such conditions always a simple matter, even when it is held within the grasp of the surgeon. The immediate dangers surrounding such a case are considerable. Shock is apt to be pronounced, and may become so threatening as to put an end to further operative efforts. The abdominal and the pelvic structures are subjected to considerable risk from accidental injury of one kind or another, and the extensive bruising of the tissues prepares a tempting field for septic invasion.

Instead of the adhesions being plastic, they may be fibrous. An ample incision, giving a full view of the field is necessary, when the fibrous bands may be secured between ligatures and cut. The position of the iliac vessels and the ureter must be remembered. They lie beneath the parietal peritoneum, but it is a very easy matter at times to injure one or all of them by heedless manipulations. The general principles of surgery alone can guide the operator amid complications impossible to individualize.

Care not to expose the gut to cold, caution in dealing with adhesions, patience in applying ligatures and perseverance along safe lines are the rules that govern such cases. Several points must be guarded. The gut must not be denuded of its peritoneal coat by the rude tearing of adhesions. Fibrous adhesions, if wide and vascular, should be divided with caution between clamps by blunt-pointed scissors. A little compression is often sufficient to control the bleeding. The blood-vessels coursing through such adhesions are rarely of much consequence of themselves, but it must not be forgotten that fibrous tissue is not contractile and that a tiny vessel will bleed indefinitely unless arrested by natural or artificial forces. Fibrous threads can be snapped and disposed of by a few twists at each end. Vessels can frequently be identified and tied with fine catgut before they are cut. Where a ligature cannot be placed, a stitch may be used. Torsion is very often the most rapid and effective method of dealing with these small bleeding points.

Recent general adhesions must be broken up by blunt dissection, for which purpose the forefinger is the most admirable instrument. A steel instrument, however blunt and servicable in surface work, must not be introduced into the abdominal cavity for this purpose. These adhesions bleed sharply sometimes, but sponge compression is generally sufficient to control the hemorrhage. If the oozing resist dry sponge compression, hot sponges may act very promptly. Should the outpour continue beyond reasonable limits a gauze plug (*not a drain*) may have to be left within the abdomen until the hemorrhage ceases and the plug can be safely withdrawn. It must be remembered that new adhesions will promptly form around the plug and that it may not be possible to remove it for ten days or more. In these conditions the gauze must be literally rammed and packed against

the bleeding surfaces; compression, not drainage, being the direct object in view. Such a plug will rarely be required if a little patience and skill are directed against the surface oozing.

The use of the sponge is an acquired art. It is not difficult to learn it. Bleeding surfaces must not be raked and filed, but gently and evenly compressed without agitation or hurry.

The intestines and the omentum sometimes rush over the field of operation and into the wound in such a manner that the operator is greatly embarrassed in his work. In the face of such a difficulty no headway can be made and it becomes necessary to put the patient into the TRENDELENBURG position, whereby the intestines are forced against the diaphragm out of the operator's way. Should the respiration of the patient become too labored in this position, as it does in rare instances, the project will have to be abandoned and the operation completed by other means. A temporary application of TRENDELENBURG'S position, until the offending viscera can be walled off by a large towel and held by an assistant, is frequently all that is necessary.

The vermiform appendix sometimes defies removal in the living subject. The adhesions may be so widespread and powerful that the most resourceful surgeon is powerless to overcome the complications. The attempt at removal should not be pushed beyond the limits of prudence, under the mistaken impression that the appendix can always be removed by a skillful operator and that a failure to do so would be accepted as a proof of his want of surgical qualities.

Here, again, it is impossible to frame a general rule that would cover the given case. The surgeon who is performing the operation is the authority whose judgment in any case must stand until some one who certainly knows more about it can be heard from.



FIG. 24.
Patient in the TRENDLENBURG position.

The operative technique will necessarily vary with the individual surgeon. A trained and resourceful man is himself an authority, and such alterations as he may make from the beaten path are generally the outgrowth of solid experience and are just as successful as other more widely accepted methods.

Few operators employ a median incision in uncomplicated cases; many open the peritoneum at the outer border of the right rectus muscle. In making the latter incision the precise location of the deep epigastric artery must be remembered. This vessel is of great importance by reason of its being the chief source of blood supply to the wall of the abdomen. It is a branch of the external iliac and lies between the transversalis and the peritoneum. Two veins accompany the artery, and bearing in mind that it arises just below the internal abdominal ring and flows upward and inward, its location can be perfectly made out by the exploring finger. If necessary it can be pushed out of the way of the scissors for a short distance, but its size and strategic position are not likely to protect it from those who, on general principles, prefer a liberal use of ligatures to a knowledge of surgical anatomy.

The operation devised by MCBURNEY¹ differs simply in the method by which the abdominal wall is divided. Briefly, the muscular layers are separated by blunt dissection in the line of their fibres, not cut by the knife. The first incision is through the skin, following the trend of the external oblique aponeurosis, and is of necessity three inches or more in length. The underlying layers are then gently separated without cutting, each layer being drawn aside by retractors to expose the layer beneath, until the peritoneum is opened, when the technique is the same as that usually employed. By this procedure the

¹*Annals of Surgery*, July, 1894.

strength of the abdominal wall is hardly disturbed and the complication of ventral hernia is practically impossible. Very few stitches are required to unite the parietal wound, as the tissues fall into easy apposition when the retractors are withdrawn. This operation is not suited to any but experienced operators. It is by no means easy of accomplishment. Where the surroundings are favorable to its application few feats in surgery are more satisfactory.

DRAINAGE.

The successful practical application of drainage depends very largely upon a thorough knowledge of its theory. The indication for draining a purulent cavity is self-evident, yet, in abdominal work, the obligation is just as great to establish drainage, if possible, in advance of its actual necessity.

When the nutrition of a part is disturbed, the natural drainage responds in a corresponding degree. If the part become gangrenous, the normal channels are overwhelmed, and isolation of the part or artificial drainage must be depended upon to save the organism itself from the spreading ravages of sepsis. The isolating plan of nature, illustrated in the formation of limiting abscess walls, does not always succeed, and sepsis may destroy life unless drainage be supplied by surgery.

The supply of nutrition is no more important in the circuit of life than the elimination of waste materials. It is *confined* filth that works mischief.

The peritoneum is the most energetic and resourceful antagonist, when threatened by infection, of any tissue in the human body. Its powers of absorption are very great, and, unless its vital tone is lowered by systemic disease, or by injury, it can neutralize or destroy appreciable quantities of septic

matter. When its strong powers of absorption are insufficient to protect it from advancing sepsis, it deliberately surrenders a section of its territory and begins at once the construction of a mechanical wall around the rebellious part. It is here that the resources of surgical art becomes so conspicuous in the saving of life. Should the timely amputation of a septic focus come to the aid of the peritoneum in advance of the collapse of its first resource, the service to humanity is ever greater than it is in a desperate extremity. Preventive surgery is a noble art, well worthy the companionship of preventive medicine.

The escape of infectious matter into the peritoneal sac may bring about one of several terminations.

The pus may become encysted, undergoing various changes, finally ending in more or less complete absorption.

It may become the starting-point of an abscess, the growth of which depends upon several factors, some mechanical, some constitutional.

It may not meet with successful mechanical resistance by the peritoneum, and thus give rise to diffuse peritonitis.

Diffuse peritonitis is usually septic (or purulent), but in some instances it is plastic. In the latter form the plastic exudate may be entirely absorbed, or remain in the form of obstructing bands, or may break down and become purulent.

A peritoneal abscess of appendicular origin may destroy life by mechanical pressure; it may cause pyæmia; it may break into the alimentary tract at some point; it may burrow into distant regions; it may rupture into the bladder, or the vagina, or be discharged through the abdominal wall externally. Its most probable course, unless it be opened by an operation, is rupture into the free peritoneal cavity by reason of the collapse of the abscess wall. This wall may be broken by coughing, or vomit-

ing, or may collapse spontaneously without apparent mechanical interference. Much depends upon the virulence of the infection.

The surgical problem presented by the vermiform appendix is entirely one of drainage. The devices of art must come to the rescue of those of nature when the latter have broken down. The familiar phrase, "an operation for appendicitis," simply refers to a surgical project undertaken for the purpose of instituting artificial drainage, or of forestalling its necessity.

The general principles involved must be applied individually to every case under treatment. Fortunately, there is small prospect of error if an adequate general knowledge be combined with proper caution.

A clean case requires no drainage. Such a case will generally be so clean throughout that the question of drainage is not once brought seriously before the operator's mind. The peritoneal cavity contains but a few drachms, at most, of thin, clear serum; the peritoneal surfaces nowhere show evidences of more than hyperæmia; the stump of an unruptured appendix, the surface of which is free from a tiny speck of grayish lymph, has been buried beneath a scarified ring of cæcal peritoneum; all cut surfaces are dry and clean; no gut has been stripped of its serous coat; the tissues have not been bruised by rough handling; there is no trace of sepsis in evidence, and, more than this, there is no reason to suppose that any will appear. Such a cavity should be closed without hesitation.

It is more difficult to define precisely the conditions demanding drainage.

An undue quantity of serum, while not of itself a sufficient cause for drainage should command the most cautious examination of the affected area with reference to the presence of some minute source of infection. The thinner and the clearer the

serum is, the better. Thick, syrup-like serum is of a very serious character, and will probably be associated with the landmarks of sepsis that leave no doubt in which class the case belongs. Flaky serum, regardless of its quantity, or of any other condition, demands drainage.

Too much confidence must not be placed in an unbroken serous coat of the appendix. While *every* case of appendicular perforation must be drained, it does not follow that every non-perforating case should be closed without drainage. In all cases the serous coat of the appendix should be inspected with the utmost care, and if the minutest speck of grayish lymph is attached to it, no further question as to the necessity for drainage is possible. This speck of lymph, sometimes approximating the size of a pin-head, conceals a tiny perforation, and, while the area involved appears to be very small, human senses cannot at the moment verify the extent of the infection, hence drainage is imperative.

Should the stump of the appendix, for any reason, not be buried, a small drainage wick should be used. The danger from secondary perforation about the ligature is very small under such conditions, but the risk from a drainage wick is smaller.

Doubtful tissue, in whatever quantity, wherever found, demands a drain.

The mere separation of plastic or of fibrous adhesions, however extensive, does not of itself call for drainage, although the procedure may accidentally give rise to a condition in which it is safer to drain.

Extensive gangrene of the interior of the appendix may exist when nothing beyond the first stages of plastic inflammation are present in the peritoneum, and when the dangers of peritoneal

sepsis are removed by the amputation of the appendix the peritoneum may confidently be left to care for itself without drainage.

In all acute attacks in which the appendix defies removal, a drain should be inserted for the reason that it is impossible to say what course the case may take.

Every case of peritoneal sepsis must be drained. From this rule no departure is permissible under any circumstances. No amount of flushing, no vaunted chemical solution, no individual method can take the place of drainage in this condition. No matter how clean a septic area may be made to appear—the cleaner the better, always—a drain must be employed.

Every doubtful case should be drained. The individual operator is the judge of his case and of his own work. If the tissues of the patient are suspicious, or if his own manipulations are faulty, he should know it, and act accordingly. It may here be remarked that a personal whim is one of the most dangerous elements ever introduced into surgical work. The operator who is in “the habit” of draining is only less dangerous than the surgeon whose “habit” is never to drain.

Before an abdomen is closed, it must be known beyond a reasonable doubt that it is free from present or impending sepsis. In providing drainage, it is not required of the operator that he shall know beyond a reasonable doubt that the cavity is septic. Knowledge, as positive as human senses can make it, is demanded in the former case; a well-grounded doubt is abundantly sufficient in the latter.¹

The proper course to be pursued is rarely a matter of doubt,

¹ NOTE.—A closed wound is one in which the divided tissues are brought into apposition without any provision whatever for artificial drainage. A drained wound is not a closed wound. A wound may be closed, or partially united, or left open. A closed abdomen is one in which no foreign substance is left for the purpose of permitting the escape of fluids from the peritoneal cavity.

but in calculating the consequences of error, it must be borne in mind that a well-established drain does not seriously mar the patient's prospects for recovery, whereas the mistake of closing a septic abdomen is practically certain to end his life.

The necessity for drainage having been decided, the ways and means of carrying it into effect have to be determined.

Tubes of any description are most undesirable. It is dangerous to leave an instrument of this character in contact with the viscera, for the reason that the physical presence of the tube is of itself an irritation, and instances are known where perforation of the intestine has resulted from this cause. A more serious objection is that a tube does not, in the proper sense, drain anything; it merely serves as a channel through which liquids will flow according to the law of gravity.

On the other hand, gauze meets the requirements most admirably. It is not dangerous to leave it in contact with peritoneal surfaces, and its powers of capillarity are highly developed. In spite of some speculation to the contrary, gauze does not readily become clogged by the secretions from the wound. It can be so arranged by proper manipulation as to cover a very wide surface area without interfering with the physical movements of the intestines. This material can do the most effective service where tubes are utterly out of the question.

After the opening of a circumscribed abscess, the use of gauze strips an inch or more in width and a yard long, are all that are required for purposes of drainage; they should be packed carefully, fold by fold, until proper support is supplied to the abscess wall, one end of the strips always remaining outside the wound. These strips must not be rammed into the cavity in wads, but adjusted in orderly folds, so that they will uncoil without resistance when the time comes to remove them.

In all cases of drainage, the external dressings should be so abundant as to take up the discharges readily.

When it is necessary to drain freely the general peritoneal cavity, the MIKULICZ drain is superior to any other device yet suggested. In applying this drain the following steps are taken: The wound may or may not be partially closed, according to circumstances. A single thickness of gauze a foot square, more or less, is spread out with its center lying directly over the wound. The

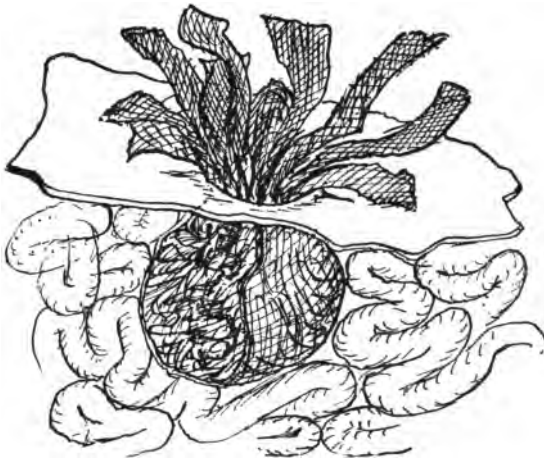


FIG. 25.

Diagram showing MIKULICZ Drain in position.

index finger now pushes the center of this square of gauze into the depths of the territory that it is desired to drain, the edges of the square remaining around the edges of the wound. As the gauze is driven home it gathers in folds about the finger, precisely as a closed umbrella folds around its center rod. A bag of gauze is now in place. This bag should be ballooned with gauze strips, applied carefully in folds, until it extends considerably beyond the limits of the wound internally. In other words,

a balloon of gauze is gradually constructed so that the body lies inside the peritoneal cavity and the stem projects externally through the wound.

It will be seen from this that a broad expanse of peritoneal surface is exposed to the capillary action of the gauze, and that a well-constructed ball-valve is formed which will not permit the viscera to escape during fits of vomiting and coughing.

When applying a drain of any description it must be borne in mind that it is a drain, and not a plug, that is desired. The gauze must be so placed that fluids will escape without hindrance, not rammed and packed in such a fashion that a dam is created.

During the first day following the insertion of a MIKULICZ drain the serous outpour is enormous; the external dressings are saturated within three hours and should be removed and replaced by others. Clean, soft towels are just as good here as pounds of absorbent cotton, and are much more economical. After twenty-four hours the attendant carefully removes a part of one of the strips, the object being to keep the drain gently disturbed from time to time in order to facilitate the outflow. Every day a strip (more or less) should be withdrawn; generally all will come away within a week. By the third day the serous flood begins to subside, and sooner or later the discharge assumes a purulent character. This should excite no alarm, so long as the drainage is free.

The gauze strips should at no time be violently removed. Gentle pressure is sufficient if they are ready to come away, and if they are not, it were better to leave them until they are.

After the strips have come away the gauze bag (or blanket) may still be firmly adherent. It will be remembered that the peritoneum has thrown a wall of plastic material all around the drain, and often into the meshes of the gauze, hence some patience

is necessary in awaiting the tendency of nature to slough out the material composing the drain. The removal of the strips sometimes leaves an open space inside the bag, which should be packed and repacked as often as may be necessary.

The gauze bag is sometimes very slow in coming away. In some cases it shows a disposition to remain permanently. Violent manipulations are nowhere more out of place than in the removal of drains. Occasionally it is necessary to apply continuous traction by so adjusting a strong pair of artery clamps that the desired object can be attained by strapping their handles to the skin some distance from the wound, using a pad of gauze as a fulcrum.

It need prove no discouragement to have one of these cases linger for weeks or even months. The patient may not be in a proper state of health to assure prompt union of wounds. A generous diet and careful constitutional treatment are essential. The practitioner who puts his faith in an array of chemicals is likely to lose sight of the fact that the most effective antiseptic is a nourishing blood current backed by an energetic vital tone.

Should the proper moment for the withdrawal of a drain be doubtful, it is well to bear in mind that it had better be left too long than removed too early.

After the removal of all the drainage material a sinus will sometimes remain a considerable time. Usually no operative treatment is required, as spontaneous healing takes place in due season. An infected silk ligature has been known to keep a sinus open for two years, and might do so indefinitely unless removed by operation. Where catgut is used such a mishap is not to be expected. Should some operative measure appear to be necessary a careful scraping under cocaine anæsthesia is generally sufficient to insure prompt closure of the sinus. An operation

for the removal of a clinging ligature is not so small a matter. Very extensive operative work has been known to fail in locating the troublesome knot.

It may be inquired whether a coil of suspicious intestine should be anchored as near as possible to the external wound. Such a course may be justified theoretically, but in practice it has not been found to be necessary. If an opening be left for drainage, by reason of suspected gut, it may be depended upon that such tissue will not travel beyond the influence of the drain. The peritoneum is quick to grasp the advantages in such a situation. The mere presence of even a minute drainage wick is sufficient in many instances to insure a localization of developing sepsis around the opening.

Friable tissue about the base of the appendix requires the use of a small drainage wick, the size of a lead pencil, which should be brought through the lower angle of the wound. Should the suspected tissue extend over a large area it would be safer to insert an ample MIKULICZ drain.

In certain cases of general infection it may be proper to insert several wicks of gauze, radiating from the wound, or to make a counter opening where such a course is demanded. In general infection, however, a single median opening, or an adequate lateral incision, is sufficient; at least, the prospects for recovery are not generally enhanced by multiple openings.

To those who put their trust in tubes of one kind or another it may be said that no tube should be left in actual contact with the visceral peritoneum. The tube should always be wrapped in gauze before it is inserted. The use of tubes, however, is not advised under any circumstances.

A provisional drainage wick (one left in anticipation of sepsis that fails to appear) may ordinarily be withdrawn within

forty-eight hours, and certainly when it is demonstrated that the condition for which it was inserted is past.

It is rarely necessary to drain the wound in the abdominal wall apart from the peritoneal cavity. In some excessively fat subjects it may be prudent to anticipate trouble by draining the fatty layer, but this can be done best in most cases by the use of a few strands of silkwormgut. The operator who makes a practice of draining fatty tissue on general principles will seldom be disappointed in producing suppuration. Few things are more certain to produce pus than a drainage tube left between fatty surfaces. A clean, dry, smooth wound in the abdominal wall should be united throughout and given the opportunity to heal by primary union.

The full requirements of drainage are not met by mechanical appliances alone. The general systemic waste pipes must be kept open and active. Violent purging is unnecessary if not dangerous, but the fecal current should be kept in gentle motion without interruption. After the insertion of a peritoneal drain the bowels must be moved within a few hours by an enema of Epsom salts, and in no case should the contents of the intestinal canal be permitted to accumulate. In threatened intestinal paralysis energetic attention to the bowels becomes imperative. Nature must be given every possible aid in the elimination of sepsis. In extreme cases a favorite enema is one composed of an ounce each of Epsom salts, water and glycerine. If a prompt response is not secured, a drachm of the spirits of turpentine should be added to the second enema.

The kidneys should not be forgotten in an emergency where unusual drainage is desirable. Watermelon, if thoroughly ripe and above suspicion, can be given *ad libitum*. Its influence is most refreshing and wholesome. It acts in a thoroughly physi-

ological manner, and in some cases its effects are extremely satisfactory.

The skin, too, should be kept active by tepid sponge baths of alcohol and water. A weak solution of soda may be alternated with the alcohol. Gentle rubbing is serviceable in many cases.

METHODS OF DEALING WITH SEPTIC CASES.

These cases may at the outset be divided into two classes: the circumscribed and the diffuse.

It is self-evident that the more perfectly the septic invasion is limited by the peritoneum the more favorable are the patient's chances for recovery. Some septic cases are managed with the utmost ease; at other times they present complications that defy the most skillful and experienced operators.

A Large Circumscribed Abscess.—A familiar condition, especially in cases that have lasted more than a week, is one in which a "tumor" is more or less distinctly made out in contact with the anterior wall of the abdomen. Its location is not fixed.¹ Sometimes it lies just above the center of POUPART'S ligament; at other times it approaches the median line on a higher level; again it lies snugly in the right iliac fossa. This "tumor" if gradually enlarging, and accompanied by the symptoms of localized suppuration, is almost certainly a collection of pus, bounded internally by a plastic wall having for its support coils of gut, the mesentery, and a plug of omentum, and externally by the wall of the abdomen. "Tumors" composed of plastic lymph sometimes become very prominent upon palpation, but they are less painful than the abscesses, and present as a rule, a different clinical history.

¹See article on "The Location of the Appendicular Abscess," by M. L. HARRIS, M.D., Chicago; *Journal of the American Medical Association*, December 21, 1895.

The differences between the plastic and the purulent "tumors" are not always clear, but generally the diagnosis is not a matter of great difficulty. The principles governing the abscess cases are the same in all instances. The precise object is to drain the abscess without breaking its internal wall at any place. If a fluctuating



FIG. 26.

An abscess "pointing" against abdominal wall; proper incision in such a case.

"head" can be found, and generally it cannot, the guide is all the plainer, but an incision, varying with circumstances, should expose the "tumor" at its most prominent point. In dividing the abdominal wall by successive strokes of the knife, large, dark veins and œdema of tissue indicate that pus is very near.

Above all things this abscess must not be stabbed with a blind slash from within outward. A sharp scalpel should be used, and not that monstrosity known as the curved bistoury. The layers are precisely the same as in clean cases, with the vascular and dropsical differences noted, and a purulent "tumor" should be approached just as any tumor is exposed, by safe cuts from without inward. The more prominent the "tumor" the greater the safety in approaching it. It must be remembered that the intestine itself forms the chief part of the limiting abscess wall and that it is likely to be wounded if the incision be carried too far.

The accompanying diagram (Fig. 27) shows the relation of the parts. An incision of too great length not only endangers

Section of abdominal wall.

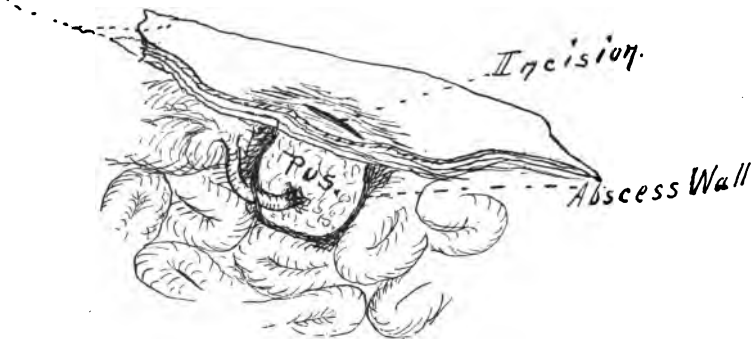


FIG. 27.

Diagram showing relation of the intestines to the abscess wall; perforated tip of appendix lying in the abscess, its base extending into free peritoneal cavity

the gut but renders the clean peritoneal cavity liable to an invasion of pus. When the peritoneum of the abdominal wall is divided pus gushes out. The finger is carefully introduced and the incision is enlarged as fully as the limits of the abscess wall will permit.

At this point the experienced operator requires no advice, but the young surgeon must bear well in mind that he is not "operating for appendicitis" but for a circumscribed peritoneal abscess of appendicular origin. With the appendix out of his mind his finger is not so likely to work mischief. The appendix should not be searched for, and on no account must the supporting wall of the abscess be broken at any point. In the diagram referred to (Fig. 27), will be seen the perforated tip of an appendix lying within the abscess cavity while the base of the appendix lies in the free peritoneal cavity. It would, under these circumstances, be manifestly impossible to release the base of the tube without destroying the admirable wall of defense constructed by nature for the purpose of circumscribing the infection.



FIG. 28—Operating Pad.

It is well to flush the abscess cavity thoroughly. In such a case an operating pad is very desirable.

The author has suggested an irrigation outfit, the portable parts of which are a piece of rubber tubing eight feet long, a metal bow, and a pair of artery forceps. This outfit is easily sterilized, is inexpen-

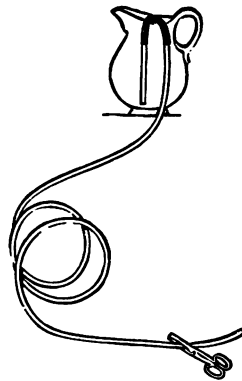


FIG. 29—Irrigation outfit.

sive, has no joints to get out of repair, and the tubing can, moreover, be used for an ESMARCH bandage in cases of emergency. The metal bow prevents the rubber from kinking over the edge of the reservoir; the current is started by stripping the tube, and a pair of artery forceps serve as a clip.

The abscess cavity having been carefully irrigated, it should be dried by gentle sponging, and a number of gauze strips introduced, one at a time, until the packing is snugly applied at every point of the cavity. The packing is necessary by reason of the unstable character of the lymph wall, which might be broken down by a spell of vomiting, thus inflicting upon the peritoneal cavity a fresh dose of infection.

The gauze strips require much care for their proper introduction. They should be applied in little folds, so that traction upon the ends left without, will bring about their prompt withdrawal. No strip must be carried into a wound under any circumstances unless one end is left several inches long on the outside. A wad of gauze lost in such a cavity might provoke a dangerous complication and perhaps kill the patient.

When the packing has been well adjusted a liberal dressing of gauze and absorbent cotton should follow, the whole being retained by a wide bandage encircling the abdomen.

The packing should be removed every day, oftener if necessary, and fresh strips introduced. The external dressings may be changed whenever they become sufficiently soiled to demand it. A cavity of this character generally closes quite rapidly. Fewer strips of packing material are demanded from day to day. Irrigation is not advisable in subsequent dressings.

When the abscess cavity has been obliterated by granulations it may appear desirable to close most of the parietal wound by stitches, but the attempt to hasten union by such a method is not likely to prove successful. Nor is it prudent at such a time to provoke a spell of vomiting from an anæsthetic. Granulation will ordinarily close all parts of the pus tract with sufficient rapidity.

These cases should be confined to bed until wound union is complete. A flat pad should be worn for some months after the patient is permitted to return to his business pursuits.

While the cavity is granulating a nourishing diet is necessary. The appetite should be gratified as fully as may be consistent with prudence. A daily movement of the bowels should be procured by means of a saline enema. Constitutional remedies are of the highest value at such times.

A Small, Ill-defined "Tumor" presents a problem more difficult of solution. The indications may clearly denote the presence of pus, but the precise "point" of the abscess cannot be defined. The purulent area lying in contact with the abdominal wall may be very small, and the gut may be coiled so closely around it that even a most cautious operator might wound it in an effort to evacuate the pus. The parietal peritoneum, a layer of plastic lymph, and the intestinal peritoneum may be so fused by the inflammatory process that identification is utterly impracticable. An operator who is at home in these tissues may be trusted to select his own route for reaching the pus, but it may frequently appear the safer course deliberately to open the peritoneal cavity away from the abscess, where an adherent gut is not likely to be met with. With the free cavity clearly demonstrated, the object is to remove the pus without contaminating the uninfected peritoneum. Gentle exploration will reveal the little "tumor" glued to the parietal peritoneum at some point. The next step consists in the adjustment of gauze pads in such a manner that the viscera cannot come into contact with the "tumor." The way is now clear for the removal of the pus. This procedure may be undertaken at once, or it may be left for a future day. Should it be thought best to meet the issue immediately, a blunt aneurism needle should be pushed through

the abscess wall and withdrawn. A few drops of pus appear; they are instantly received upon a sponge. Slowly the pus is pressed out, a few drops at a time, until the quantity is much diminished. It is then proper to enlarge the opening, the object being always to withdraw the pus so slowly that none of it can by accident get beyond control and run into forbidden territory. When it appears that the pus is practically exhausted, the finger breaks the abscess wall and clears a tract into which a drainage wick can be inserted. On no account must the protecting pads, first placed, be disturbed until firm adhesions have formed behind them. After this they can be removed, a little at a time, as the adhesions begin to suppurate. A part of the external wound may be closed or not, as the indications may demand, and the drainage apparatus should be adjusted in accordance with whatever conditions may be present.

The preliminary pads should be left alone for a week or more, until a reliable lymph wall shall have formed and they have begun to loosen according to natural processes.

It will sometimes be two weeks or more before they will come away in proper manner. The abscess packing is a different matter. It should be changed as often as necessary.

The operator in some instances, after locating the abscess and walling off the clean peritoneal cavity with gauze, may decide not to disturb the pus at all, until reliable adhesions have formed around the gauze packing, and such practice is undoubtedly good surgery. Within a few days the abscess wall can be punctured and its contents let out with comparative safety. Should the abscess rupture spontaneously, after a few hours, no great harm is likely to follow, since a ready outlet is at hand and protecting adhesions form with considerable speed.

Surgery being a human art, no amount of foresight and

caution can in all cases prevent an accidental rupture of the abscess wall and a more or less extensive soiling of the peritoneum. The safe transportation of deadly filth through clean peritoneal tissues is not on any account a tempting procedure, and must frequently fail of entire success for obvious reasons. It can hardly be denied, however, that such a mishap had better occur under the eye of a trained surgeon, than take place by a blind accident of nature. Little trust can be placed in the ordinary abscess wall, and it must not be rammed by a bungling finger. The lymph barrier is of uneven strength and it is ruptured with astonishing ease. A complication of this sort must be dealt with at once. As much filth as possible should be washed out, the appendix searched for and removed, and the most complete drainage established. Under such conditions MORRIS¹ uses the hydrogen dioxide liberally within the free peritoneal cavity and accords it the first place as an agent for the destruction of infection. This complication is a most undesirable one, but the issue having been forced by an accident, nothing short of radical treatment is advisable.

INFECTION OF THE FREE PERITONEAL CAVITY.

If this condition is not promptly recognized and dealt with at once it is impossible to define the bewildering array of complications that follow.

The lines between *circumscribed and diffuse infection* are not always clear, and frequently a distinction is impossible. Generally speaking, a *median incision* is indicated where the latter condition is probable. Abundant room is essential. No time should be lost by reason of a cramped incision. With some exceptions, the appendix can be removed with tolerable

¹ *Lectures on Appendicitis*, 1895, p. 63.

facility through an ample median incision, and the other complications can be dealt with without the limitations necessarily imposed by a lateral opening. In some cases of widespread infection no time should be wasted in a fruitless search for the appendix. The operator will be fortunate if he open the abdomen

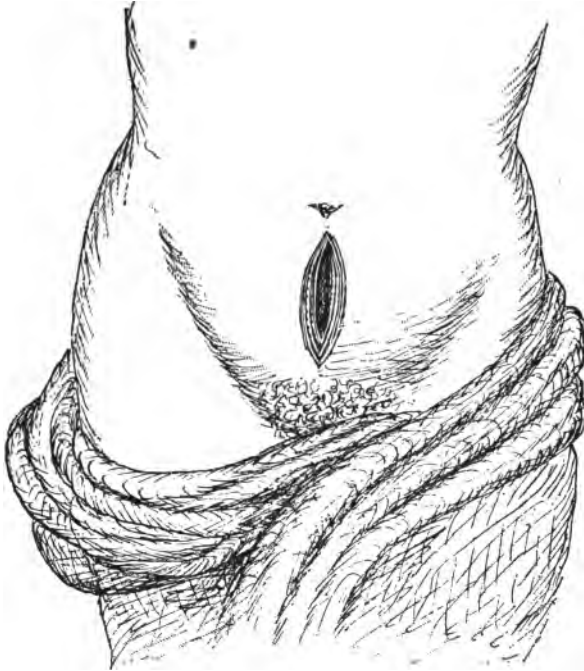


FIG. 30.

Proper incision in cases of widespread complications.

rapidly by a long median incision, break down the abscess walls, wash out the pus with hot salt water, insert a drain, and get his patient to bed alive. Not a moment should be lost in closing any part of the wound.

The appendix itself may rupture without substantial warning (*Fulminating Appendicitis*) and cause widespread infection, or

an abscess wall, instead of growing stronger, may be ruptured from various causes, permitting purulent fluids to overwhelm the peritoneum with a sudden gush.

Where the former condition is present, prompt operation will usually reveal a gangrenous appendix, ruptured at one or more points, surrounded by partially paralyzed intestine, traces of fecal matter, flakes of lymph, some frail omental adhesions, and the pronounced traces of approaching peritonitis. The appendix should be grasped and tied off at its base, without an attempt at burying the stump. Few patients in this condition are prepared to endure a prolonged operation, and the highest speed consistent with perfect safety is demanded. The area of infection, if small, can be gently wiped with sponges, but where considerable *debris* is present, it is proper to flood the cavity with a stream of hot salt water and continue the flushing until all gross particles of filth are washed out. The hot water is a prompt and entirely physiological tonic and its beneficial influences are soon in evidence. It is out of the question to leave excrement scattered about in the peritoneal sac, and the hot saline solution is the safest agent for its removal. Some object to free irrigation on the ground that it spreads the infection. Considering the fact that the infection is already widespread, the objection is hardly a valid one. Irrigation is not an agent for indiscriminate use; no surgical method is; but in its place it is indispensable. It is perhaps the only direct cleansing agent that fortifies the patient against shock.

The use of poisonous chemical solutions within the peritoneal cavity is condemned by all experienced surgeons. Such solutions are not only dangerous but useless. Hot physiological saline solution is never irritating to the tissues. In cases of diffuse infection, where flakes of lymph and puddles of pus are

widespread, the hydrogen dioxide is of great value. It does no injury to the tissues, and its power to disorganize and neutralize the products of decomposition is remarkable. A pint or more of this liquid should be freely poured into the infected cavity and allowed to remain for three or four minutes, when large quantities of the saline solution should follow it.

The Spontaneous Rupture of an Appendicular Abscess does not necessarily outrank a tiny perforation of the appendix in producing fatal sepsis. As stated in a previous chapter, it is the virulence of the infection rather than the extent of the contamination that decides the issues of a case. The treatment of this condition should follow the general rules elsewhere found. Extensive and prolonged flushing is necessary. Gangrenous tissue of whatever character, wherever found, should be removed if possible, the living tissues properly protected, and abundant drainage provided.

Infected Omentum is generally in evidence in all perforating cases. The quantity involved may be very extensive. Sometimes a gangrenous appendix will be so buried within folds of the omentum that the intestines are hardly involved in the complication. The infected tissue is drawn outside the wound and secured by clamps. These are held by an assistant while the surgeon cleanses his hands anew, after which the tissue is tied in small segments and cut away at a point some distance from the infected area. It should not be tied in a mass, as a ligature is tied around an artery. First, a dull aneurism needle, armed with catgut, is made to transfix the omental pedicle, after which the ligature is slowly and patiently tied. All the suspected tissue should be cut away. It is not of much consequence how much is amputated, if the ligatures only include small segments and are securely placed.

Perforation of the Intestine, generally near the base of the cæcum, is sometimes found, and demands prompt closure. A purse string suture, passed only through the peritoneal coat and coapting the serous surfaces over the rent, is very satisfactory in the case of small round perforations. Long, jagged holes require a series of interrupted LEBERT sutures. The mucous membrane must be neatly inverted and buried after the fashion of the stump of the appendix. It may be well to insert a double row of these sutures, provided the bowel is not thereby constricted too greatly. A perforation of the gut under such conditions is likely to be surrounded by a border of treacherous tissue, and if the stitches will not hold after correct application it may be the best practice to establish a fecal fistula without delay. This can be done by stitching the affected area of cæcal tissue snugly into the external wound. Where a perforation already exists the threads can properly be passed through all the coats of the cæcum and tied in such manner as will bring the serous coat of the cæcum and the parietal peritoneum into contact. Strips of gauze should protect the peritoneal cavity from escaping fecal matter. An earnest effort should be made, however, to close all perforations where it is possible to do so. Some risk is justifiable under the circumstances, and the drainage can be adjusted with a possible failure of the stitches in mind.

Occasionally a perforation is located at the base of the appendix but slightly overlapping into cæcal tissue. This opening must not be tied like the end of a meal bag, leaving the puckered mucous membrane of the cæcum exposed. The proper procedure in such cases is to tie the base of the appendix and then invert the stump and the perforation adjoining it by a purse string suture.

It is sometimes found that the cæcum cannot be raised from

a bed of adhesions sufficiently to permit the proper treatment of the condition found at its base. A gangrenous appendix can often, under such conditions, be twisted off and removed partially or entirely. Gangrenous tissues do not bleed, and the amount of force used should not be sufficient to lacerate the sound structures. Drainage will be demanded in any such event, and it were better to halt within safe lines than to incur the risk of ramming a hole into an inaccessible gut.

Concerning the questionable condition of the cæcum, and of the ileum at times, a stream of hot salt water is quite as serviceable here as it is in strangulated hernia, in enabling the surgeon to decide upon what treatment to apply. A steady stream of the saline solution will either so improve the circulation as to create hope in the revival of the gut, or prove that it is doomed by gangrene. A perplexity of this character has arisen where the appendix has snared a coil of intestine.

In cases of widespread infection it may sometimes be proper to stitch a section of the wound. No time should be lost in applying separate sutures to the different layers. A few stitches of silkwormgut, including all the layers, are perfectly satisfactory under such conditions. The operator is striving at such a time to save life, not to prevent a subsequent hernia, which, in a clean case, it would be his plain duty to forestall.

In all cases the operator must exercise care in not making a bad matter worse by thoughtless manipulations. It is unpardonable, after amputating a segment of gangrenous omentum, to handle clean surfaces without first cleansing the hands, yet blunders of this sort are by no means confined to young operators. The utmost vigilance is necessary in making *all* the steps of the operation comply with the established principles of surgery.

SPECIAL COMPLICATIONS.

A Fecal Odor coming from the wound need occasion no surprise in certain cases. The wall of the gut has given way at some point and the liquid contents of the bowel are passing through the external opening. No especial treatment is required at the time. Cleanliness must be observed as far as possible. This complication generally disappears spontaneously within a reasonable time, and the less it is meddled with the better. Should it persist, however, it becomes utterly intolerable, and the case must be rare in which operative relief is not advisable. No new principle is required in the operation. The serous surfaces of the gut are scratched gently and brought together in such a way as to close the opening. The stitches must be of fine chromicized catgut or fine silk and must be very skillfully applied. The rule never to include all the coats of the gut in a plastic suture must be remembered. A small drain is necessary.

Acute Mechanical Obstruction of the Intestine. This complication sometimes follows an operation for appendicitis. It is rare in the clean cases. In the septic cases it is far more frequent, but in all cases of obstruction following a septic operation it is practically impossible to make a diagnosis between mechanical obstruction and paralytic obstruction from sepsis. The process by which the peritoneum seeks to limit the spread of infection is not free from positive dangers to the gut, a coil of which may be strangled by the inflammatory exudate, or by an omental band, or by the appendix itself.

The appearance of the symptoms of obstruction following a clean operation should command instant attention and receive prompt operative relief. An operation performed under such conditions offers much hope of saving the patient. The abdomen should be rapidly opened in the median line, the seat of

constriction located, the gut released and brought into the wound for examination. If it be gangrenous the dead portion must be resected at once and one of two methods adopted without delay: an artificial anus should be established, or the ends of the gut brought together and united by means of stitches (MAUNSELL'S method) or by FRANK'S or MURPHY'S anastomosis button. The establishment of an artificial anus is not to be thought of if there is the least prospect of uniting the divided ends. The immediate danger to be feared is death from shock.

In septic cases this complication is one of the gravest that may be imagined. Even were a positive diagnosis possible, the prospects of operative relief are very small. The case is, however, so certainly doomed if left without operation that the project may be undertaken if in the judgment of the operator it be deemed advisable. The surgeon who undertakes the relief of any case of intestinal obstruction must be on familiar terms with rapid and skillful work. A blundering, halting operator would probably allow the case to die on the table—a termination to be feared in any case, and a certainty where prolonged manipulation is not avoided.

An Omental Abscess occasionally develops after the subsidence of the more acute general symptoms. Generally this complication follows the amputation of a segment of omentum, and the including of too great a mass of this tissue in one ligature may be said to favor the complication. The symptoms are those of circumscribed peritonitis. A "tumor" soon develops against the anterior wall of the abdomen, upon either side of the median line, frequently as high as the navel. This "tumor" is characterized by firm limiting adhesions, and becomes more prominent day after day. Pain is sometimes severe. The proper treatment, after the adhesions have become sufficiently secure, is

to let out the pus through a vertical incision and drain the abscess cavity with gauze strips. There is no reason why this cavity should be "subjected to exploration"—a technical phrase for aimless fumbling. The rule in peritoneal abscesses, to open the abscess and not to open anything else, should be borne in mind.

Ventral Hernia. This complication rarely appears in the history of a case in which the divided layers of the abdominal wall have been securely united by accurate suturing. After McBURNEY'S operation, if properly executed, it is practically unknown. Following septic cases it is not unusual, although an operator who is experienced in the technique of abdominal drainage can prevent it in nearly all of his cases. The treatment of this condition should be in accordance with the general rules of surgery. In some cases a flat pad, properly adjusted, is all that is advisable. In properly selected cases, a favorable moment should be chosen for bringing the gaping layers together and stitching them with chromicized catgut. The success of the procedure depends very largely upon the skill employed in closing the transversalis aponeurosis.

The various abdominal and pelvic organs may become involved by reason of an infection spreading from the appendix, but it would be impracticable to attempt to define all the secondary lesions due to this affection. The proper treatment in any case is the application of the rules of modern surgery. In all cases the judgment of the individual operator must decide what course to follow in a given case, since he alone is aware of the peculiar conditions that confront him.

Re-Opening the Abdomen. To re-open the abdomen for an early post-operative complication is justifiable in clean cases, but if the procedure be prompted by an extension of sepsis, recovery

is not to be hoped for. No doubt the practitioner will at times be tempted to re-arrange the drainage and flush the cavity again, but the shock will probably be fatal, and in no instance has such a procedure been effective where a former effort has failed. Concerning this matter BECK¹ says: "If after a laparotomy the patient's abdomen has been closed, his fate is determined."

Shock. This complication is due to perforation of the walls of the appendix, permitting the free peritoneal cavity to be invaded by infectious matter; to the rupture of an abscess wall, from coughing, vomiting, or careless manipulations; to the breaking down of inflammatory and other adhesions by the operator; to the exposure of the intestines to cold; to traction upon the mesentery, and in some degree to the prolonged use of the anæsthetic.

By the exercise of proper care, the degree of shock is seldom threatening in clean cases; in septic cases the powers of systemic resistance are more or less weakened, and dangerous shock is by no means rare.

While operating within the peritoneal cavity the liberal use of hot saline solution does more to control shock than any other agent. This applies to all cases of whatever character. In clean cases, where extensive adhesions are encountered, shock is sometimes considerable, and it is often advisable under these conditions to throw a quart of the solution into the peritoneal cavity before the wound is closed. This procedure is generally sufficient, but an enema of hot coffee is very efficacious and may be given as soon as the patient is returned to bed. Should the hot coffee not be at hand the saline solution can be used in its place.

One of the following remedies may be administered:

¹ *Manual of Surgical Asepsis*, Philadelphia, 1895, p. 151.

Camphor. The patient is very cold and collapsed; pulse almost imperceptible; restlessness at times.

Veratrum album. Abundant cold sweat, especially on the forehead; thirst; face pale, cold and sunken.

Strychnia nitrate, administered hypodermatically in doses of 1:40 of a grain, is more widely employed, perhaps, than any other drug in the treatment of shock. Nitro-glycerine, in doses of 1:100 of a grain injected subcutaneously, is a most prompt and energetic stimulant. Digitalis is also used in cases where cardiac weakness is pronounced.

The value of alcohol is undoubted, but its injudicious use has produced much mischief. Two ounces of brandy, mixed with a pint of hot salt water, and thrown into the colon gives very satisfactory results in many cases.

The vital remedy is *heat*, promptly and effectively applied in whatever form it is most applicable to the given case. Hot water bags are essential in *preventing* shock and in *treating* it; enemata of hot coffee, hot salt water, or hot brandy and water, are likewise doubly useful; and an extreme case should receive a pint of hot physiological saline solution direct into a vein. In less severe cases this solution serves admirably when thrown through a small needle into the subcutaneous tissues of the back. It is a mistake to suppose that the intra-venous injection should be employed only in cases of hemorrhage. Capillary inertia, which is present in shock, is really a form of hemorrhage, although the blood does not escape from the vessels.

The intra-venous infusion is a simple operation, requiring no great skill for its proper performance. It is unnecessary to say that surgical cleanliness is taken for granted in anyone who attempts it. The large superficial veins in the bend of the elbow are readily made prominent by throwing a tight cord about the

arm. One of these vessels is exposed by a longitudinal incision and two ligatures, a few lines apart, are thrown around it. The vein is then opened by a slit following its course; the clean tip from a fountain irrigator is inserted and secured by the ligatures. The current of physiological saline solution (a teaspoonful of common salt to the quart of sterilized filtered water at a temperature of 105°) is now permitted to flow into the circulation. No air must enter the vein. A pint of the solution is generally sufficient but a quart is often used. When the pulse has sufficiently responded the tip is withdrawn and the vein tied above and below the slit. The skin is closed with a running suture of catgut and smeared with collodion. Subsequent injections can be thrown into the subcutaneous tissues.

MATERIALS FOR LIGATURES AND SUTURES.

These materials, by reason of their vital bearing upon the success of operative procedures, demand special consideration.

The materials commonly employed by surgeons for securing vessels and uniting wounds are silk, catgut, and silkwormgut. The last named is by far the most admirable substance in all cases in which the subsequent removal of the stitches is contemplated. It is not suitable for the tying of vessels nor for suturing the intestine. It is comparatively cheap, is easily sterilized, and, in its sphere, undoubtedly occupies the first place in the minds of all operators who are familiar with its qualities.

Silk is almost an ideal ligature material, being inexpensive, very easily sterilized, and readily holding a knot, but it is not absorbable, and its tendency to promote chronic sinuses has induced many operators to abandon it in all cases where its early removal or prompt encysting cannot be hoped for. When it is

thought best to use it, a section of fine bass-line, having been boiled with the instruments, is perfectly satisfactory.

Some writers advocate the use of fine linen thread, but operators have not found it preferable to silk in any way. In cases of emergency the familiar domestic cotton thread has been used with satisfactory results.

Catgut, if properly sterilized, is the ideal ligature and suture material for nearly all abdominal operations. Some operators, indeed, use it almost universally.¹

Having chosen a proper size of raw catgut, three steps are essential before it is ready for surgical work: (1) It must be freed from fat; (2) it must be subjected to the hardening influence of some chemical, and (3) it must be effectually sterilized.²

As a preliminary step the raw strands should be cut into desirable lengths (from eighteen to twenty-four inches), and wound into coils as shown in Fig. 31. These are soaked in benzine for two or three days and then allowed to dry.

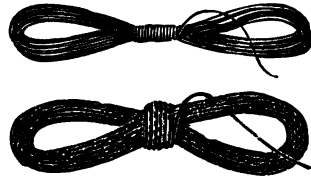


FIG. 31.—Coils of Catgut.

To harden the coils, they are immersed for from eight to twelve hours in an alcoholic solution containing one grain of potassium bichromate to the ounce. The bichromate should be first dissolved in hot water, and the alcohol added very slowly, to prevent precipitation.

When the action of the hardening solution has been prolonged sufficiently, the ligatures are transferred to a jar of

¹See article on "The Preparation of Catgut and its Use in Abdominal Surgery," by Dr. HOMER I. OSTROM, of New York; *The Medical Times*, June, 1897.

²For an exhaustive and valuable treatise on Catgut, the reader is referred to the article of CHARLES W. EATON, M.D., of Des Moines, which appears in the *Transactions of the American Institute of Homœopathy for 1896*.

absolute alcohol and boiled under pressure for thirty minutes. They are then preserved in absolute alcohol until ready for use.

Some very experienced surgeons prefer the boiling in commercial alcohol containing five per cent. of strong carbolic acid.

Many operators believe it desirable as one step, in the sterilizing process, to soak the coils for a day in a 1:4,000 alcoholic solution of corrosive sublimate.

Dr. I. S. STONE,¹ of Washington, D. C., after freeing the coils from fat, soaks them in water for twenty-four hours, then places them in a five per cent. solution of the ordinary forty per cent. formalin of the shops and allows them to remain for thirty-six hours. Boiling is not necessary after the action of the formalin and Dr. STONE says that gut thus prepared "meets every requirement in surgery where absorbable material is required."

¹ *Journal of the American Medical Association*, April 24, 1897.

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